

UNIVERSITY OF WOLLONGONG



RESEARCH REPORT
1991-92

Front cover

Marine Ecology in the Illawarra. Research Assistant in the Department of Biology in the Faculty of Science, Graeme White samples sub-tidal ascidians, relatives of the familiar sea squirts. This field of research in marine ecology is a component of the Australian Flora and Fauna Program conducted by Dr David Ayre and Dr Andy Davis (Co-ordinators Associate Professors Rob Whelan and Tony Hulbert) and is fundamental to an understanding of the design and implementation of conservation zones for marine invertebrates

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University of Wollongong
Northfields Avenue
Wollongong NSW 2522

Telephone: (042) 21 3555
Facsimile: (042) 21 3447

All inquiries related to research should be
addressed to the Deputy Vice-Chancellor



UNIVERSITY OF WOLLONGONG

RESEARCH REPORT 1991 – 1992

Contents

VICE-CHANCELLOR'S INTRODUCTORY REMARKS	4
--	---

RESEARCH PROGRAMS

Advanced Materials and Surface Engineering	6
Advanced Telecommunications	10
Applied Economic Modelling	12
Applied Mechanics and Advanced Manufacturing	16
Applied Statistics	20
Asia and Pacific Development Studies	22
Australian Flora and Fauna	24
Bioactive Molecules	26
Biological Macromolecules	28
Bulk Materials Handling and Physical Processing	32
Education Policy	36
Industrial Automation	40
Labour Market Analysis	44
Literature and the Colonial Legacy	46
Quaternary Environmental Change	48
Science and Technology Analysis	52
Water Engineering and Geomechanics	55

RESEARCH GROUPS

Analysis Research	58
Applied Cognitive Studies	60
Contemporary Arts Practice and Performance in Australia	62
Engineering and Industrial Mathematics	64
Experimental and Analytical Stress Analysis of Structures	66
Fossil Fuels	68
Fundamental Properties of Semiconductors	70
Intelligent Polymeric Materials	72
Labour History and Industrial Relations	74
Language, Learning and Equity	76
Management Strategy and Organisational Change	78

Physical Activity and Ageing	79
Public Health Research	80
Software Engineering and Intelligent Systems	82
Structural Engineering and Construction	84
The Tasminides	86

DEVELOPMENT GROUPS

Accountability and Financial Reporting	88
Clinical Counselling and Health Psychology	90
Curriculum Research	91

CENTRES

Centre for Multicultural Studies	93
Centre for Research Policy	94
Key Centre for Mines	95

INDIVIDUAL RESEARCHERS

(for research outside of Programs or Groups)

Ashbolt, Dr A	History and Politics	96
Beran, Dr H	Philosophy	96
Brown, Dr D	Psychology	96
Burgess, Dr J	Philosophy	96
Cincotta, Assoc. Prof. V	Modern Languages	97
D'Alton, Dr P	Sociology	97
Dean, Mr A	ITAC	97
Dodds, Ms S	Philosophy	97
Dunn, Dr R	Philosophy	97
Harland, Dr R	English	97
Hawley, Dr D	Modern Languages	98
Heim, Mr C	Creative Arts	98
Ianziti, Dr G	Modern Languages	98
Jeanjean, Mr H	Modern Languages	98
Kiernan, Dr I	History and Politics	99
Laird, Dr P	Mathematics	99
Lee, Mr H	History and Politics	99
Lloyd, Professor C	Graduate School of Journalism	100
Mansfield, Ms U	ITAC	100
McCarthy, Assoc. Prof. B	Modern Languages	100
McLaine, Dr I	History and Politics	100
Mitchell, Dr G	History and Politics	101
Mohr, Dr R	Sociology	101
Nulsen, Dr P	Astronomy and Astrophysics Projects	101
Rando, Assoc. Prof. G	Modern Languages	101
Reglar, Dr S	History and Politics	101
Simpson, Dr D	Philosophy	102
Steele, Assoc. Prof E	Biology	102
Tognetti, Dr K	Mathematics	102
Unjacke, Dr S	Philosophy	102
Vezgoff, Ms T	Sociology	103
Vickers, Dr A	History and Politics	103
Zealey, Assoc. Professor W	Physics	103

PUBLICATIONS

(listed by Department within Faculty)

Faculty of Arts

Department of English	104
Department of History & Politics	105
Department of Modern Languages	105
Department of Philosophy	106
Department of Science & Technology Studies	106
Department of Sociology	107
School of Creative Arts	108
Graduate School of Journalism	111

Faculty of Commerce

Department of Accountancy	111
Department of Business Systems	111
Department of Economics	112
Department of Management	113

Faculty of Education 114

Faculty of Engineering

Department of Civil and Mining Engineering	116
Department of Materials Engineering	118
Department of Mechanical Engineering	119

Faculty of Health and Behavioural Sciences

Department of Human Movement Science	121
Department of Nursing	122
Department of Psychology	122
Department of Public Health and Nutrition	123

Faculty of Informatics

Department of Computer Science	124
Department of Electrical and Computer Engineering	126
Department of Mathematics	128
Information Technology and Communications Unit	129

Faculty of Law 129

Faculty of Science

Department of Biology	131
Department of Chemistry	132
Department of Geography	133
Department of Geology	134
Department of Physics	134

THE PERIOD since the 1990–1991 *Research Report* has seen the consolidation of the Graduate Faculty as the entity through which all intramural-funded research is supported and monitored. The Graduate Faculty is responsible for the implementation and evolution of the University's Research Management Strategy, which at the end of 1991 required the review of the 30 original Research Programs.

The review process led to the decision to continue funding of 17 of the Programs in their current form, with guaranteed funding for a further three years, and the establishment of 20 Research Groups with a lower level of funding. The criteria used to differentiate between the two are based on:

- quality and quantity of publications produced and spread of publications across members;
- external funding applied for/received with weighting given to grants received from competitive granting bodies that are recognised as being based on peer review;
- number of individual members who have received external funding;
- number of postgraduate students and post-doctoral staff associated with the research;
- evidence of co-operative research;
- number of national/international keynote and invited lectures given by members;
- number of distinguished research visitors who have spent time with the researchers, the nature of activities undertaken and the outcomes attributable to their involvement; and
- the potential for further development.

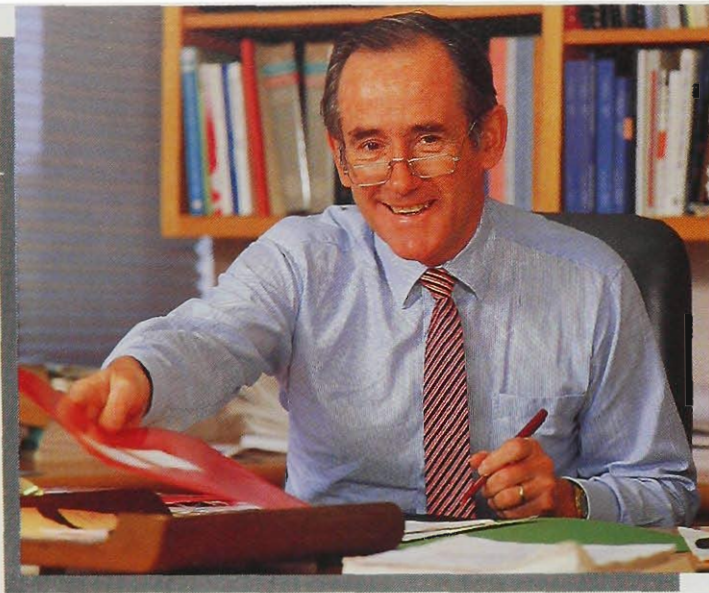
The Graduate Faculty also continues to support within the University individual researchers of quality, whose work is not related to any particular larger unit.

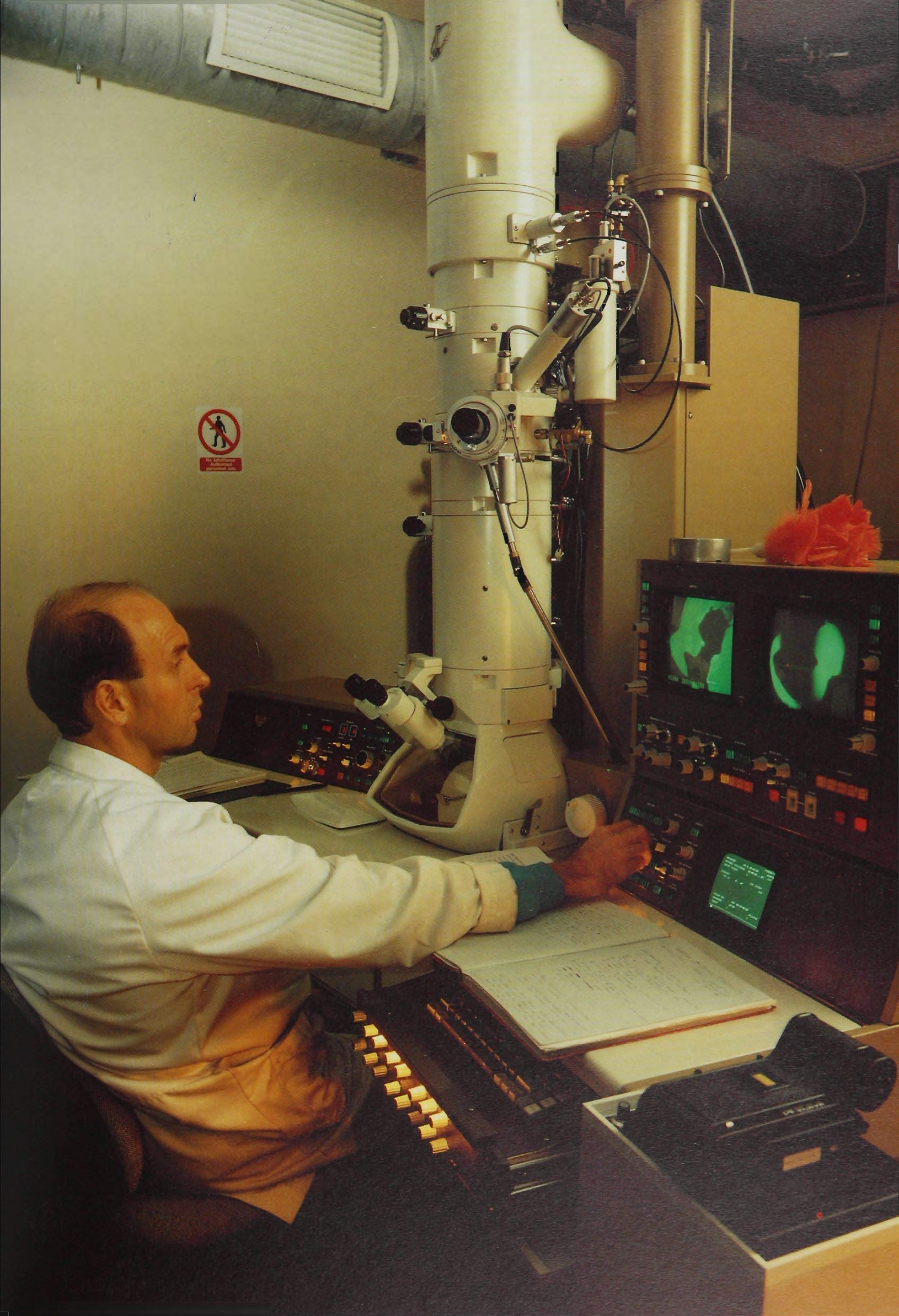
An integral part of the Research Management Strategy is the encouragement of Research Programs and Research Groups to allocate postgraduate scholarships, aiming to increase the knowledge base surrounding specific research.

The University is in the process of aggregating its major research activities for which it has international recognition. This is in line with the vision of the Research Management Strategy which aims to further the research effort of the University by providing an environment for co-operative and collaborative interdisciplinary research with a view to developing research excellence, quality postgraduate training and strong and progressive links with leaders in relevant community organisations.

The Research Management Strategy across the campus – reflected in the improved status of the University in the competitive Grants funding hierarchy. The quality of the research being undertaken is highlighted in this report. I encourage you to judge for yourself.

Ken McKinnon
Vice-Chancellor and Principal
March 1993





Members: Dr T Chandra, Associate Professor G Delamore, Associate Professor N Kennon, Dr S Nightingale, Dr G Spinks, Professor N Standish, Dr D Wexler (all from the Department of Materials Engineering).

THE ADVANCED Materials and Surface Engineering Program is focused on the investigation of new processing methods and new combinations and compositions of materials, with the overall aim to develop materials and processes with potential for commercial exploitation. Research projects are unified by the objective of developing and evaluating advanced materials through the investigation of the relationships between their structures and properties.

The projects highlighted in this report are concerned with **surface engineering of materials**; the main University researchers are M Samandi, N Kennon, D Dunne and G Spinks, with strong interaction from G Conran (Royal Australian Mint), G Collins, Australian Nuclear Science & Technology Organisation (ANSTO) and P Mercer of BHP Sheet and Coil Product Division (BHP SCPD).

The great majority of engineering compo-

nents degrade gradually or fail catastrophically in service through surface-related phenomena such as wear, corrosion and fatigue. Most cost effective and, in most cases, the best practical solution is the application of traditional and innovative surface engineering technologies in order to produce a composite material with properties unattainable in either the base or surface materials.

Modification of surfaces for the purpose of improving appearance or performance has been practiced for many centuries. However, it has been only in the past 10 to 20 years that attention has been given to the scientific and engineering aspects of surface modification, leading to the emergence of the discipline of surface engineering. Although a subset of advanced materials technology, this is a field of stature and importance in its own right. Surface engineering can be applied in a wide range of the engineering applications of materials, from the processing of agricultural plant, mining equipment and automobile components to surgical implants.

A balanced group of applied and scientific research projects is being conducted within the Program; its aim is that of establishing a centre of excellence in surface engineering – with an interna-

tional reputation – which will conduct strategic applied research for commercial exploitation within the Australian manufacturing sector.

Research within the Program covers development of new processing technology, characterisation of surface properties and optimisation of performance.

A brief summary of some of the current projects is given below.

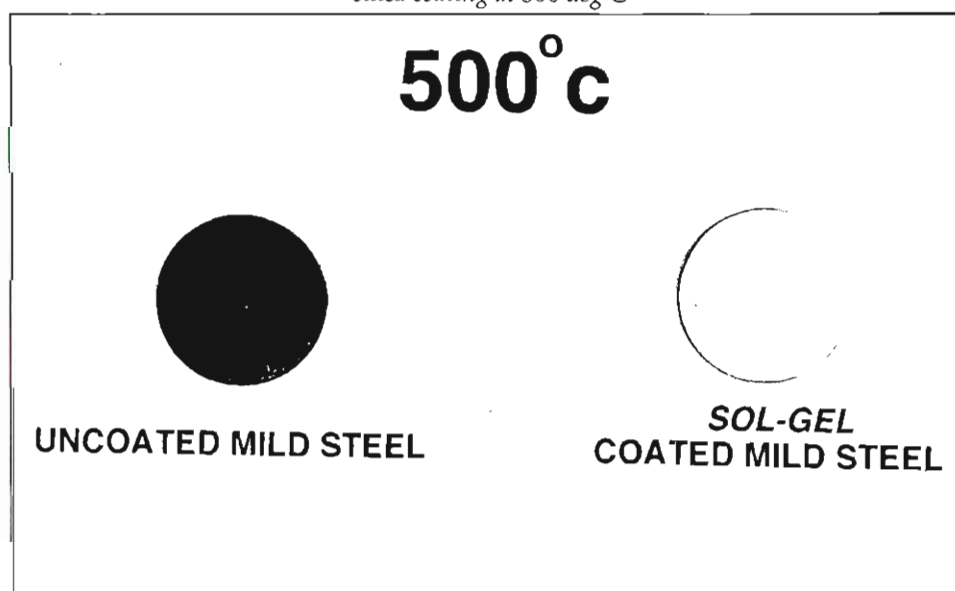
Sol-Gel Ceramic Coatings

Conducted through a Generic Industry Research and Development (GIRD) project, with BHP SCPD and C-ramic Australia as industrial partners, the project aims

- to develop a new, low-cost, ceramic coating to combat wear and corrosion, thereby enhancing the competitiveness of Australian manufacturing industries;
- to disseminate, as widely as possible, information concerning the advantages offered by ceramic coating;
- to expand the market for ceramic coatings.

Sol-gel ceramic coatings are among the latest additions to the extensive portfolio of surface-engineering technologies. Examples of oxide coatings which have been successfully deposited are $\text{YBa}_2\text{Cu}_3\text{O}_{7-x}$, high T_c -superconductors, CeO_2 for oxi-

Figure 1: Coupons of coated and uncoated mild steel showing the oxidation resistance of the silica coating at 500 deg C



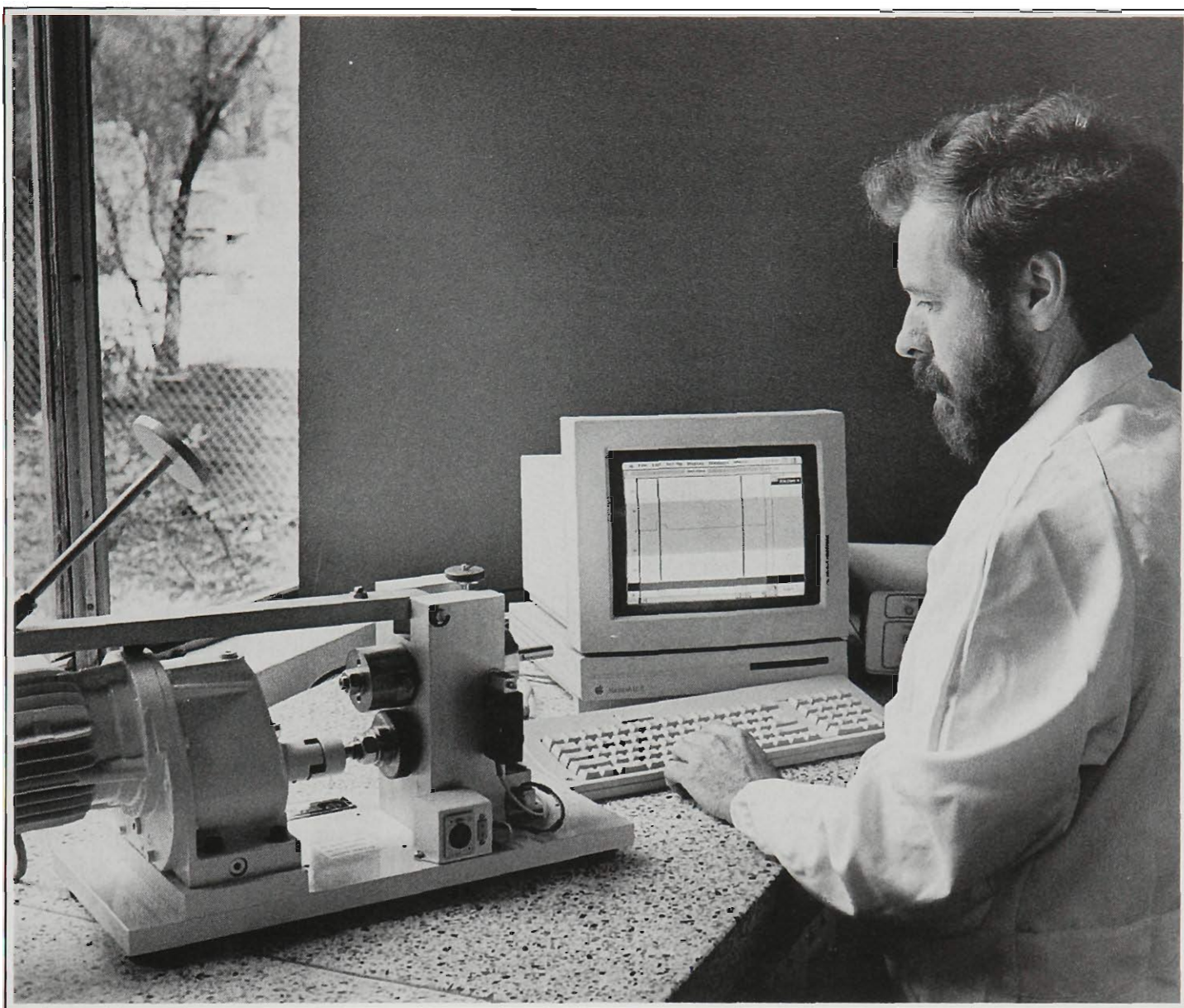


Figure 4: Mr Stephen Blayney, a research assistant in the Department of Materials Engineering, operates the Cameron-Plint T.E. 53 Multi-purpose Friction and Wear Tester, which is connected to a Macintosh LCII Computer

dation protection, mixed $\text{SiO}_2\text{:TiO}_2$ as anti-reflectance coating for Si solar cell and SiO_2 as a protective barrier against oxidation and acid corrosion with enhanced scratch resistance.

Sol-gel coatings are basically formed via two routes. The first involves polymerisation of metal alkoxides. This route is very complex and requires expensive precursors and sophisticated processing facilities. The deposited films are extremely thin and unlikely to be suitable for industrial applications for the foreseeable future. The second route involves preparation of solution of aqueous colloidal dispersions (sol) of

oxide or hydrous oxide. Liquid films are dried to form gels which are then decomposed to oxide at a calcining/sintering temperature between 300-500 C. A sol-gel silica coating has been developed and patented in the course of the GIRD project.

This silica coating has shown remarkable hot oxidation resistance, as illustrated in figure. 1. Moreover, simulated wear testing has indicated that the wear rate of stainless and mild steel substrates can be reduced by almost two orders of magnitude. More interestingly, friction coefficients typical of lubricated contact have been obtained in dry wear testing,

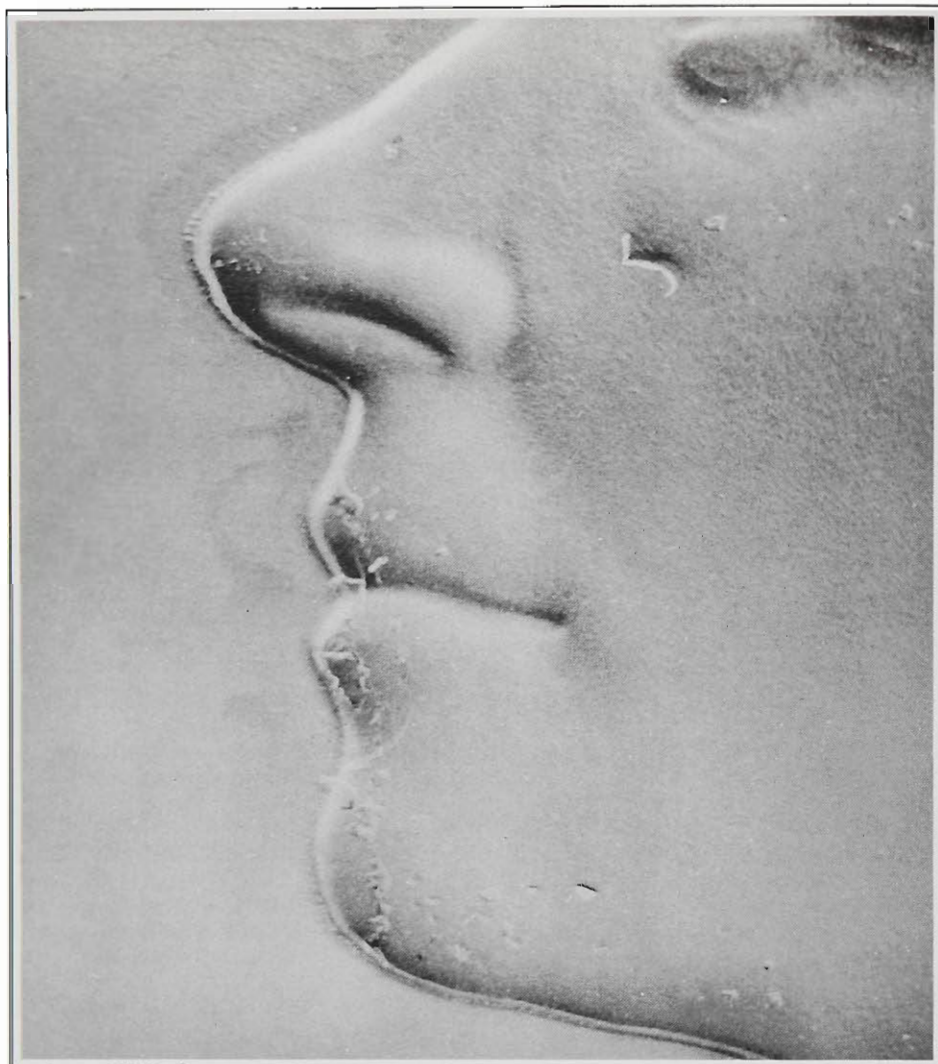


Figure 2: Part of the surface of a chromium-plated tool-steel die for coining of five-cent pieces. Damage to the Queen's 'face' is evident as a result of the coining operation

Surface Engineering of Coinage Die Tool Steels

From Roman times the minting of coins has been an index of a nation's sophistication in materials technology. The Royal Mint in Britain, for example, was a leader in the Industrial Revolution and, currently, thanks to intensive worldwide competition, advanced manufacturing technology has delivered unprecedented levels of productivity. The employment of very fast presses (up to 650 strokes/min), together with the use of more-difficult-to-press materials (e.g. aluminium bronzes used for Australian \$1 and \$2 coins), requires tools which are carefully designed and made from highest-quality tool steels. The greatest demands are placed on coining dies, since the long life of these components is required to keep down the tooling costs per part.

Traditionally, coining dies have been coated with a hard chromium layer to protect the die surface from stress marks produced during coining. These radiating marks on the die surface are the result of metal flow and scratching by minute hard particles during the coining operation. Chromium coatings are not however suitable under heavy impact conditions and are usually ex-foliated. Figure 2 shows the damage caused to the chromium-plated die during the coining operation.

In a collaborative research program between the Royal Australian Mint, the University of Wollongong, Commonwealth Scientific & Industrial Research Organisation (CSIRO) and ANSTO, a committed effort is under way to find better and less costly ways to obtain increased die life. To improve die life, highly alloyed die steels and/or suitable surface-engineering technologies are required. A number of surface treatments has been examined in the present investigation for use on the surfaces of coining dies. These processes include Physical Vapour Deposition (PVD) and Ion Assisted Deposition (IAD).

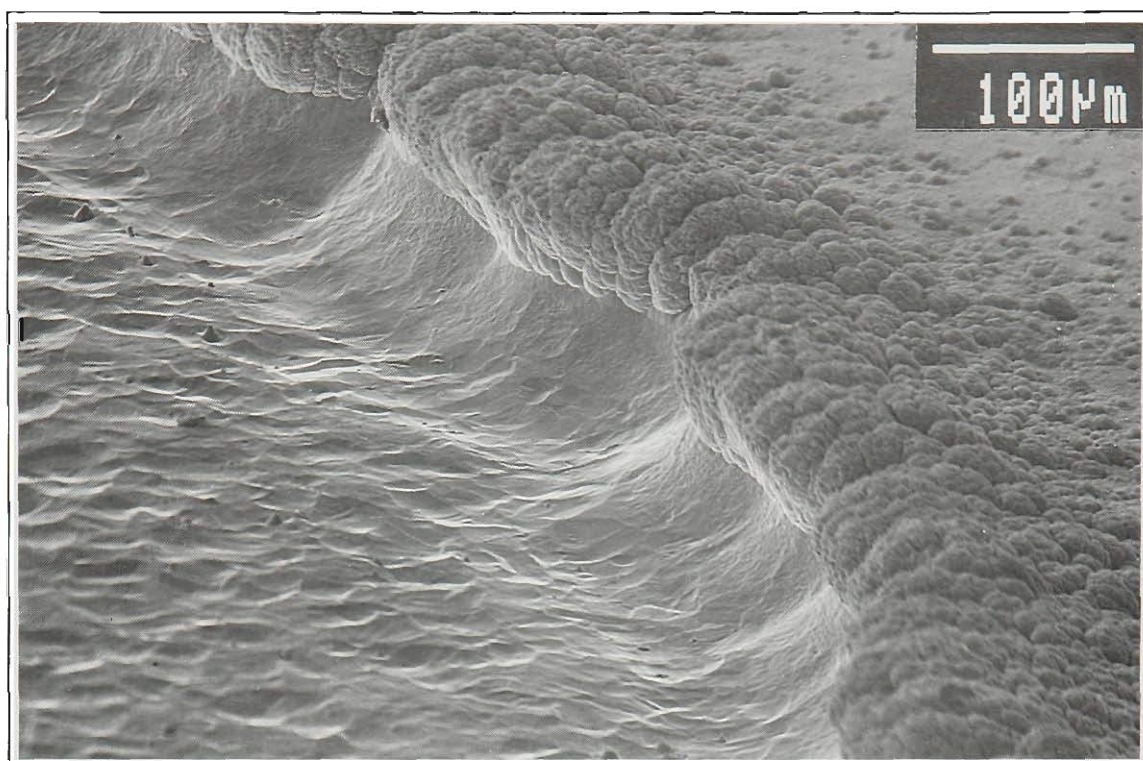
An extensive research program has already indicated that the die life can be prolonged many times by using high-

implying that the coating acts as a solid lubricant. These encouraging results have prompted a search to find suitable niche applications requiring low-friction, low-wear materials to overcome chronic industrial wear problems. Several industrial field trials are currently under way. It is estimated that the coating will reach commercial maturity within the next three to five years.

The major scientific thrust of this work has been focused on the assessment of mechanical properties of thin coatings. These properties – adhesion and strength – ultimately determine the adoption of sol-gel coating as a viable surface-engineering technology. Using ultra-microindentation equipment, it has been shown for the first time that

fracture of ceramic coatings occurs upon loading and not un-loading as previously thought. As a corollary, it has been possible to modify the coating to delay the fracture.

Figure 3: The surface of an implanted stainless-steel sample after glow discharge spectroscopy



alloy shock-resistant tool steels which are coated with a thin layer of titanium nitride applied by a physical vapour deposition method. The extremely hard coatings that are being experimented with, such as TiN, have the potential to increase dramatically wear resistance of the dies, while at the same time preventing catastrophic failure by cracking.

Development of bio-compatible materials

For several decades, austenitic stainless steels and titanium alloys have been the prime materials for applications where resistance to corrosion in aggressive environment is the paramount design consideration. However, their poor tribological properties pose serious problems in certain prosthetic and industrial applications (joint replacement, food processing and aerospace are examples). In today's industrial climate, it is not surprising that the cost- and quality-conscious engineers are increasingly demanding a cost-effective surface treatment to offset poor wear resistance without sacrificing corrosion resistance. The situation is even more acute for

human implants, where surfaces and materials are required to replicate the complex but efficient human body.

Improvement in the tribological properties of stainless steels and titanium alloys achieved by ion implantation has been widely documented. In a collaborative research program with Ansto, the potential of a new implantation technique is being investigated for the development of bio-compatible surfaces. Plasma immersion ion implantation (PI³) is a non-line-of-sight technique for the surface modification of materials recently developed by Ansto. PI³ involves the target being placed directly into an inductively coupled radio-frequency nitrogen plasma and biased to a pulsed high-negative potential which accelerates the nitrogen ions and implants them into the target. The inherent high-current density of the system, coupled with the fact that ions bombard all exposed surfaces of the target, produces significant heating and results in diffusion of nitrogen to depths well beyond the implantation range of the nitrogen ions.

Application of PI³ to austenitic stainless steel has shown that an expanded

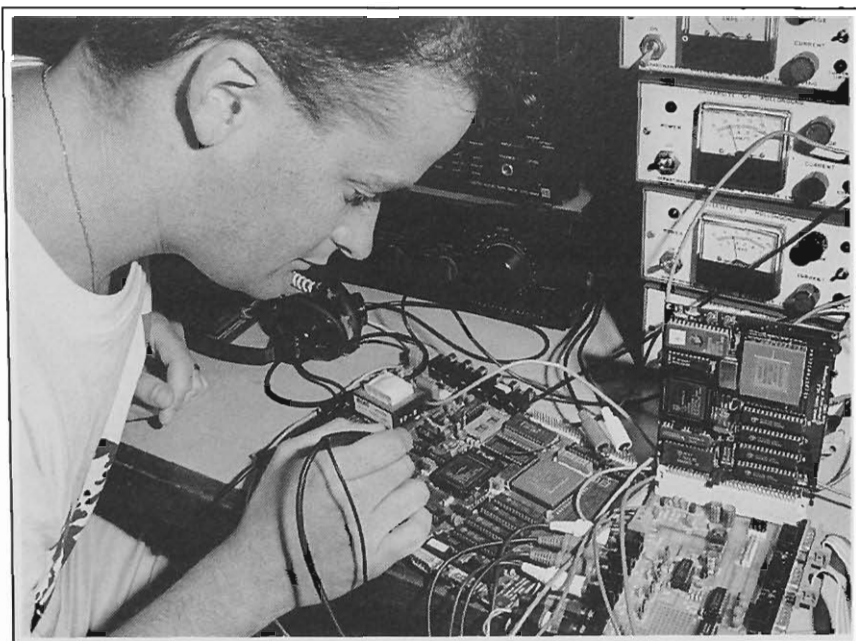
austenite phase can be formed with significantly improved tribological properties. The wear rate has been reduced by a factor of 300, while corrosion resistance has been enhanced more than 20 times.

Characterisation of implanted layers is a formidable task. A range of sophisticated analytical instruments has been used to gain an insight to the mechanism of the surface hardening and to determine the depth of nitrogen penetration and to identify the resultant phases. Analytical techniques included glancing-angle x-ray diffraction, nuclear reaction analysis, electron microscopy and glow discharge optical spectroscopy. Figure 3 shows the surface of stainless steel after glow discharge spectroscopy.

The projects described in this report form the major thrust of two of the eight sub-programs of research being conducted under the Advanced Materials and Surface Engineering Program. Each of the sub-programs constitutes a productive research activity, has attracted external research funding and involves collaboration between two or more researchers.

ADVANCED TELECOMMUNICATIONS

Co-ordinator: Professor Gary Anido (Electrical & Computer Engineering), tel. 21 3065



David Rowe developing a low bit rate CELP voice coder for use on mobile satellite telephone systems

Members: Dr P Beadle (Electrical & Computer Engineering), Professor H Bradlow (Switched Networks Research Centre), Dr J Chicharo (Electrical & Computer Engineering), Mr J Fulcher (Computer Science), Associate Professor F Paoloni (Electrical & Computer Engineering), Dr I Reinecke (Centre for Information Technology Research), Mr B Ribbun (Electrical & Computer Engineering).

THE ADVANCED Telecommunications Research Program is focused on technology that will enable tomorrow's telecommunications systems to be effective in terms of both cost and efficiency. The program has four main themes: Switched Networks Research; Multimedia Communications; Voice Coding; and Image Coding. In addition, work is undertaken into technologies, such as Very Large Scale Integration (VLSI), which support these themes.

To encourage more collaborative telecommunications research across the University, a Telecommunications Research 'Super-Program', or research cluster, has successfully been proposed. This Super-Program will be based on

the Advanced Telecommunications Research Program, and will incorporate some of the activities of the Software Engineering Group, the Computer Security Group, the Information Technology and Communication Unit, and Psychology. The vision of this Super-Program is the development of the network and customer premises technologies needed to support advanced telecommunications applications.

Switched Networks Research Centre

The Switched Networks Research Centre was formally established in May 1990 with over \$1 million of funding from Telecom Australia. In March 1992 the funding base of the Centre was expanded with a half million dollar contract from Ericsson Australia. The Centre performs research into the design and performance of advanced telecommunications networks and services such as Integration Services Digital Network (ISDN), Broadband ISDN and Intelligent Networks. The Centre conducts its work in collaboration with the University of Technology, Sydney. Currently, the Centre includes six research students, one postdoctoral researcher and two academic staff.

The work of the Centre has received

both national and international recognition. The Centre has been successful in winning bids to host the 1993 Australian Conference on Telecommunications Software, the 1993 Australian Broadband Switching and Services Symposium and the 1993 Multimedia Workshop. The Centre forms the backbone of the proposed collaborative research centre designated Global Intelligent Advanced Telecommunications Services (GIANTS). GIANTS has the very strong support of collaborative industrial partners (Telecom, OTC, HP Australia, and NorTel).

Researchers: H S Bradlow and G J Anido (Directors), I Kerekes, A Eysers, J Lawrence, D Atkinson, E Dutkiewicz, Bui Binh and M Butler (UTS).

Multimedia Communications

Multimedia communications research activities include the development of suitable architectures for Customer Premises Equipment (CPE) (that is, workstations and Local Area Networks (LAN's)) to suit multimedia applications over broadband networks, and the implications of such applications on the performance of broadband networks.

The multimedia applications being studied and developed as part of these activities are shared (or collaborative) document preparation environments, and multimedia databases (such as imaging databases).

Telecommunications services, over the next five years will make increasing use of video and imagery. The trend towards multimedia applications, graphical computer-aided design systems, high-resolution desktop publishing and so on, will make the development of efficient visual and image data compression techniques imperative.

Researcher: P Beadle.

Voice Coding

Voice coding activities have focused on the development of low bit rate coders for use in mobile communications systems, spread spectrum techniques for mobile radio systems, and the design

and analysis of intelligent speech and tone detection techniques for use in the public telephone network. Funding for these activities has come from a \$300,000 GIRD grant, a \$3 million contract from Canon, and a \$500,000 contract from Alcatel-Anritsu.

Coding of wideband audio signals is an area of great interest, particularly with the possibility for transmission via networks such as ISDN. The research activity has mainly been concerned with the Optimum Coding in Frequency coder (OCF), and the forthcoming international ISO/IEC standard MPEG/Audio, both utilising psychoacoustic weighting to mask the noise.

Researchers: B Ribbun, D Rowe, P Secker, J Kostoganiannis and I Reinecke.

Image Coding

The image coding research has concentrated on coding techniques for reducing the enormous bandwidths normally required for image and video communications. Work is under way to develop transform coding techniques which will meet internationally specified requirements.

The thrust of research in Image Coding is the unification and better understanding of Subband coders and Orthogonal Transform coders. This is evident in the amount of published work dealing with Lapped Orthogonal Transform (LOT) coding, Perfect Reconstruction (PR) filter bank design and Wavelet Transform coding. The research effort of the group is geared towards a better understanding of the coding gain of transforms and filter banks. A generalisation of the degree of overlap in LOTs is also being pursued with the aim of being able to come up with trade-offs in their usage in a network environment.

The problem of enhancing noisy images arising from medical imaging is also being addressed by the image coding group. The use of non-linear filtering techniques is being studied.

Researchers: F J Paoloni, P Ogunbona and J F Chicharo.



Researchers Professor Gary Anido and Dr Peter Beadle in a telecommunications modelling laboratory

Very Large Scale Integration (VLSI) design

A project to develop a Speech and Tone Detection VLSI chip, under a \$500,000 contract from Alcatel/Anritsu, was successfully completed. A prototype chip was delivered to industry in May 1992.

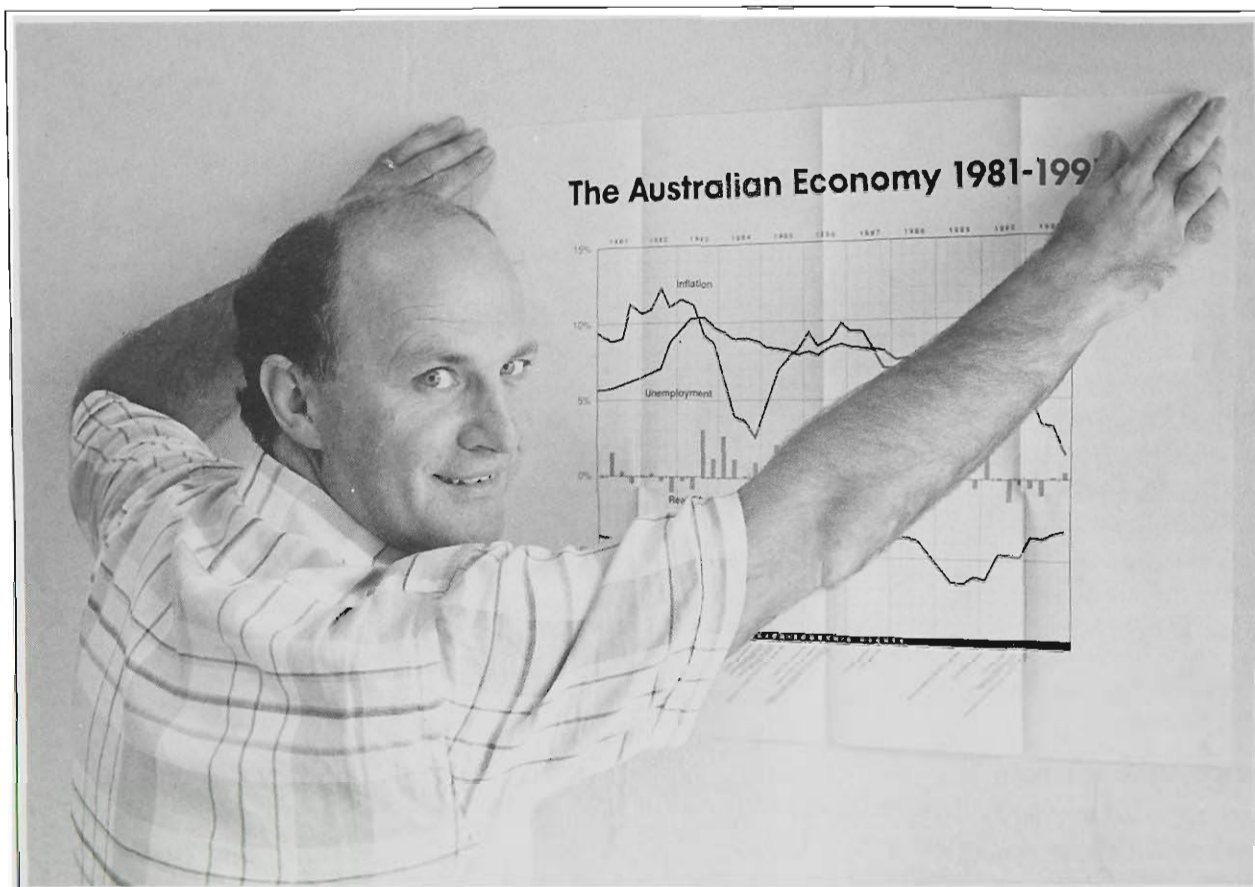
The design and fabrication of a VLSI Discrete Cosine Transform chip was funded under a \$65,000 contract from Australian Silicon Structures (Solo1400 VLSI Design Software). The project used the UNSW VLSI design tools on a Computer Science Sun SPARC station. The design was evaluated against recent commercial Applications Specific Integrated Circuits (ASICs) developed by Austek, Inmos and Siemens.

Researchers: J F Chicharo, B Ribbun, P Secker, J Fulcher and D Crook.

Research projects with industry

The research group has been working closely with industry. Co-operative projects include

- Research contracts with Telecom for switched networks and image coding.
- ISDN signalling network research sponsored by Ericsson Australia.
- GIRD Grants for speech coding and transmission.
- Industry Design software for VLSI projects – Australian Silicon Structures.
- Image Processing and Reconstruction BHP Engineering.
- Non-contact measuring systems - BHP Research and Technology Centre.
- Speech and Tone Signal Detection Alcatel (Australia) and Anritsu (Japan).
- Computer Based Measurement System Electricity Commission of New South Wales.



Acting co-ordinator from June 1992 until January 1993 was Mr Ed Wilson, seen here with a graph showing inflation and unemployment movements in the decade from 1981 to 1991

Members: Associate Professor D P Chaudhri, Dr K Y Cheung, Dr K Chowdhury, Dr C Harvie, Dr B Lee, Associate Professor A Levy, Professor D Lewis, Dr N Perera, Mr E Wilson (all from the Department of Economics).

THE APPLIED Economic Modelling Research Program started in 1991. Now it constitutes a major research activity with co-ordinating focus, the 'Applications of Economic Theory and Econometric Methods to Policy Issues' with emphasis on empirical studies of contemporary economic models for policy analysis by governments and business. The research strategy of the Program has been to facilitate an environment which encourages productive and co-operative quality research and scholarship and which receives national and international recognition and funding. Indeed that these goals are being

achieved so quickly is due to the enthusiastic and highly motivated work of a cohesive research group.

Members have published in quality national and international journals and presented papers at important economic and econometric conferences and seminars in 1991 and 1992. Four members were invited to give keynote addresses and lectures in the USA, India, Spain, Thailand and Australia. Associate Professor Tran Van Hoa visited the University of Louvain, Belgium, in 1992 and Mr E Wilson was a visiting full-faculty member in the Department of Economics, UCLA, 1991. Professor A L Nagar (Pro Vice-Chancellor of the University of Delhi, India), an internationally distinguished econometrician, was an Australian Vice-Chancellor's Committee (AVCC) visiting fellow to the program and to the Department of Economics during October and November 1992. A one-day econometric workshop on

'specification analysis' was held in his honour in early November.

A major reason for the productivity of program members has been the degree of co-operative research which has been undertaken. Recently 80 per cent of members have been working in at least one project with another member, while 50 per cent have been involved in projects with three or four other Program members. This not only reflects the unanimity of the group but also the frequent necessity to pool theoretical and applied economic and econometric expertise, in order to formulate relevant economic policy prescriptions.

Co-operation over the past 12 months has also extended to joint seminars/workshops, to visitors and to some resources with the Department of Economics and the Asia-Pacific Development Studies Research Programs.

The Program has had an active role in graduate training with four PhD and

two MCom(Hons) students engaged in relevant research activities with members of the Program (three of the PhD students have recently become associate members). In order to facilitate graduate teaching and research, the Program has purchased computerised models – 'Managing the Australian Economy' and the Murphy Model – while a large data base (which includes Organisation for Economic Co-operation and Development (OECD) and International Monetary Fund (IMF) data) is being developed jointly with the Department of Economics and the Asia-Pacific Development Studies Program.

Visitors to the Program in 1992 (in addition to Professor A L Nagar) have included Mr S Koukouras from the Treasury (Forecasting Division, Canberra), Professor N C Kakwani (Professor and Head of the Department of Econometrics, University of NSW), Professor M King (Professor and Head of Department of Econometrics, Monash University), Professor F Vella (Rice University and ANU), and Dr J Lye (Melbourne University).

A brief review of recent research work follows.

Macroeconomic Modelling of Resource Shocks

(C Harvie, N Perera, B Sootsukon, A Thaha)

Several inter-related research projects are involved in this group. Dr C Harvie has been developing a long-run theoretical framework, conducive to analysing the macroeconomic adjustment processes arising in the UK and Australia from resource-related shocks. Such a framework has been developed and applied to the UK; the next step will be its amendment and application to Australia. As part of this research a thorough analysis of the past, present and potential future contribution of resource production to each of these economies is also conducted. The future contribution is derived by simulating the theoretical model for a variety of possible resource-related scenarios, and in addition identifying how such outcomes are affected by different policy responses.

Dr N Perera has been studying supply constraints in developing economies such as Sri Lanka. This has involved using an econometric model to analyse the impact of exogenous shocks on an economy and to present some of the macroeconomic policies that might be employed to stabilise the domestic economy in response to exchange shocks. Dr Perera is also evaluating the long-term impact of export price instability in the world commodity market, on an economy with strong primary commodity sector and underdeveloped financial and capital markets.

Ms B Sootsukon and Ms A Thaha are both PhD students and associate members of the program. They are modelling the impact of external shocks to a number of developing countries of South-east Asia, in particular the effects of the authorities, economic policies on exchange rates, interest rates and development expenditure. This research clearly has a significant macroeconomic policy component which overlaps the following project group.

Modelling the Effects of Macroeconomic Policy

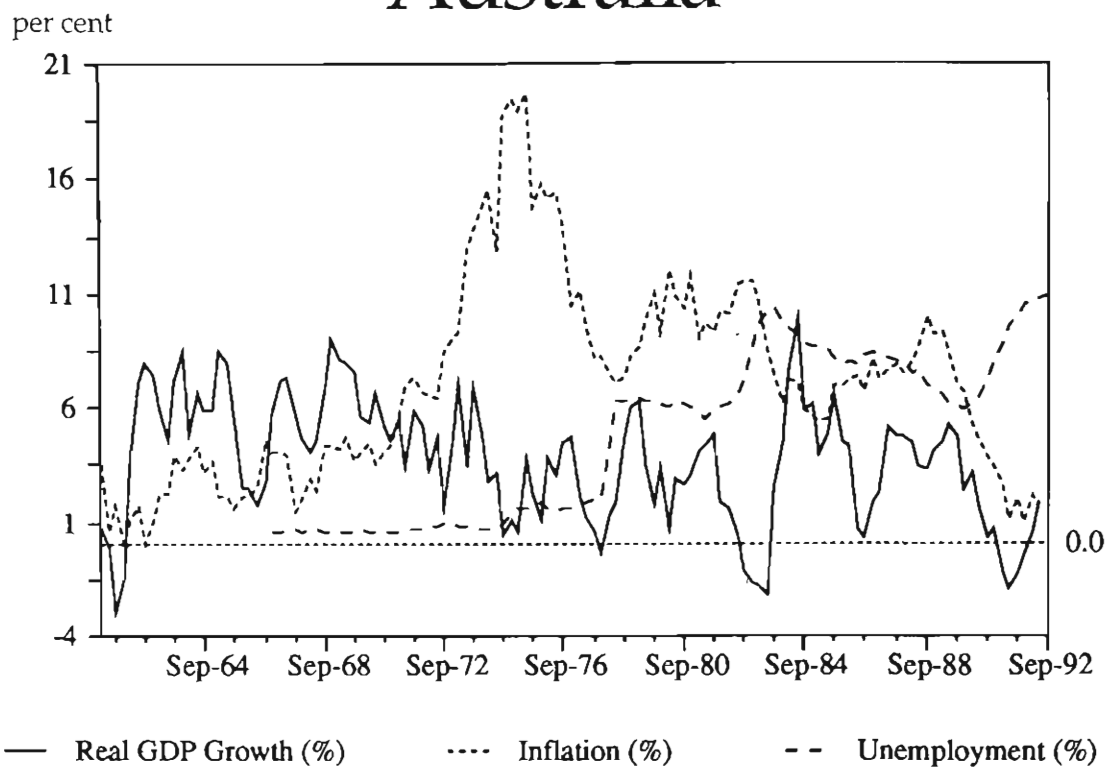
(K Chowdhury, M Chowdhury, J-H Lee, Tran Van Hoa, E Wilson)

Mr E Wilson and Mr J-H Lee (a PhD student and associate member) are jointly working on modelling wage-tax trade-offs under accommodating and independent monetary policy, with special focus on prices, the exchange rate and the balance of payments. They show that expected trade-offs, coupled with productivity gains, do not guarantee macroeconomic consistency. An interesting side result of the analysis is that monetary policy should target interest rates, in order to stabilise the economy.

Associate Professor Tran Van Hoa and Dr C Harvie are applying co-integration analysis to bivariate causality models of the long-term relationships between resource production and key macroeconomic variables such as the current account, the real exchange rate, manufacturing output and economic growth for both the UK and Australia.

Modelling of macroeconomic effects on small economies of South-east Asia has been undertaken by Dr K Chowdhury and Ms M Chowdhury (who is an associate member) during the past year. They have developed a new framework for analysing, theoretically and empirically, the marketing of labour services and determinants of economic growth.

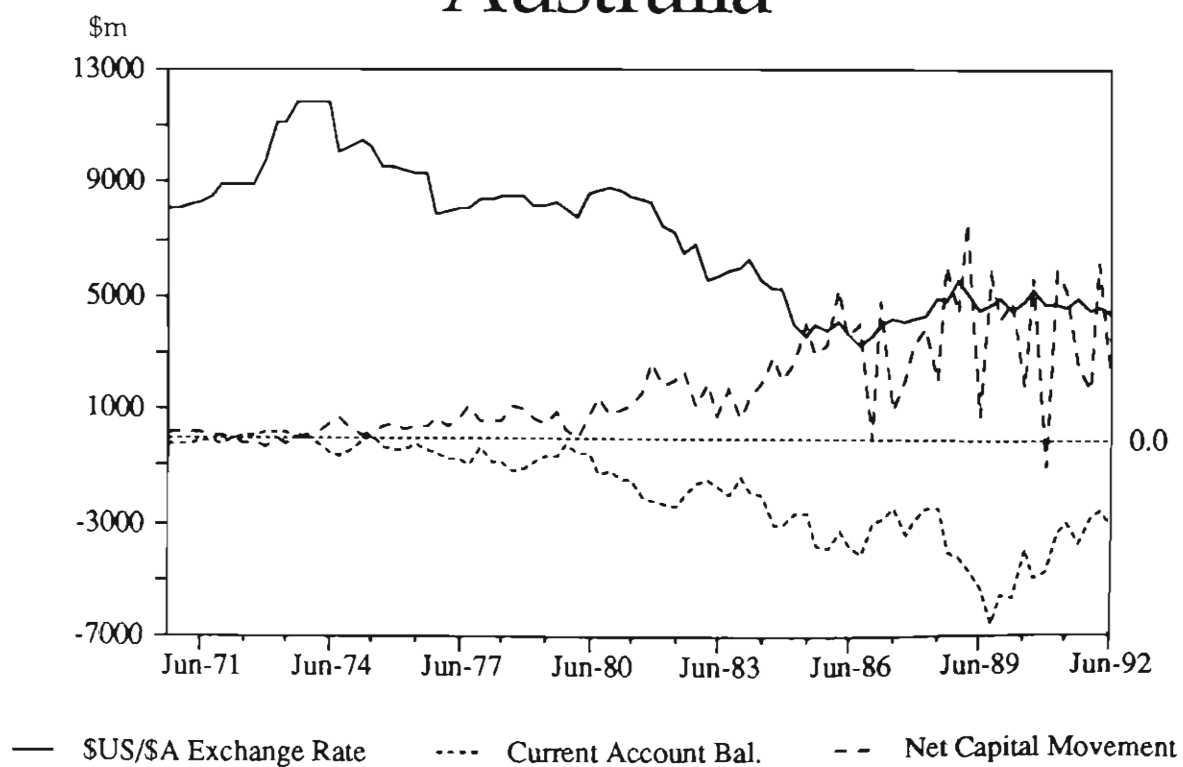
Australia



Source: Econ Data DX Data Base

Modelling the effects of wage-tax trade-offs

Australia



Source: Econ Data DX Data Base

External Debt and Agricultural Production in Developing Economies

(D P Chaudhri, K Chowdhury, B Lee, A Levy, E Wilson)

Associate Professor A Levy, Associate Professor D P Chaudhri, Dr K Chowdhury and Mr E Wilson have been working on the determinants of land allocated to major cereals in the Indian Punjab. Associate Professor Levy has developed a model of optimal land allocation under uncertainty and the group has subsequently estimated it to quantify and test the effects of yield variations, price expectations, risk aversion and money illusion on farm-land allocation in the Punjab. This project is also serving as a pilot study to a broader analysis of farm-land allocation in India.

The nexus of inter-relationships between public and private external debts accumulation, capital accumulation and production have been estimated and tested by Dr K Chowdhury and Associate Professor A Levy during 1991. This was done within a simultaneous equation system and with panel data for the period 1970-1988 on highly indebted developing countries clustered in three distinct developing regions: Latin America, Asia-Pacific and Sub-Saharan Africa.

Dr B Lee has been modelling the determinants of sovereign debt with the view to predicting future developing countries, need to reschedule debt. The research has involved estimating regressions from data for 88 developing countries over the period 1985-1989 and gives important insight into the likelihood and magnitude of debt rescheduling.

Statistical and Econometric Procedures to Improve Economic Modelling and Forecasting

(K Y Cheung, D Lewis, Tran Van Hoa, E Wilson)

Professor D Lewis has been using an econometric test devised by Granger, to examine the phenomena of increasing crime rates and falling punishment levels. The economic model of crime suggests that reduced punishment levels have reduced the cost of committing crime and are responsible for increased criminal activity. Criminologists have emphasised the opposite direction of causation, arguing that increased levels of crime have led to overcrowding of prisons and that this has led to the imposition of shorter sentences or non-custodial sanctions. The results of the econometric test provide greater support for the 'overcrowding' theory developed by criminologists than for the 'deterrence' theory developed by economists.

Dr K Y Cheung's research involves testing the joint hypothesis of market efficiency and time-invariant risk premia in foreign-exchange markets. The results of existing studies are remarkably mixed and the methodologies used usually involve estimation of equations in regression format. In this project, the signal-extraction approach,

a technique from engineering literature, is used to identify and measure premia in the pricing of 30-day and 90-day \$US/\$A forward foreign exchange. The advantage of using this approach is that it allows the inspection of the characteristics of the unobserved premium to see whether its presence, as suggested by some researchers, only adds marginally to the variability of the forecast errors.

Work on further applications of Associate Professor Tran Van Hoa's modelling approach and new and improved estimation and forecasting 2SHI theories to microeconomic and macroeconomic problems has been carried out using data from developed and developing countries. During 1993, Tran Van Hoa plans further developments of his 2SHI estimators in a comparative framework to establish their statistical relative efficiency with respect to other conventional methods such as the maximum likelihood and, more importantly, in practical applications with emphasis on policy implementation. During 1992 Mr E Wilson has been theoretically examining possible systematic effects on a new and popular specification test for nonlinearity in macroeconomic and financial variables. He presently is illustrating how the test may be biased, under a number of commonly occurring conditions.

Members: Professor G Arndt, Dr A Basu, Dr P Cooper, Dr G Montagner, Dr E Siores, Dr W-K Soh, Professor M West, Associate Professor R Wheway (all from the Department of Mechanical Engineering), Dr T Chandra (Materials Engineering), Dr X Fang (Centre for Advanced Manufacture and Industrial Automation) and Dr L-Y Shue (Business Systems).

SINCE THE beginning of 1992, two research groups to Applied Mechanics and Advanced Manufacturing have been formed within the Applied Mechanics and Advanced Manufacturing Research Program, to provide a sharper focus for previous research interests in the Department of Mechanical Engineering.

These groups have conducted active research collaboration with the Departments of Materials Engineering and Mathematics, and with industries such as MM Metals, BHP Steel Slab & Plate Products Division (SPPD) and Sheet & Coil Products Division (SCPD), Pacific Power, Defence Science & Technology Organisation (DSTO), Nippon Oil, Sandvik, Iscar and Caltex etc. Although the groups represent diverse research interests, they have formed two units with strong interaction among the members in these projects.

Rolling Mill Technology and Tribology

Studies on rolling-mill technology have been carried out on gauge variation of strip, thermal stress in work rolls, hot-plate leveller, friction at the strip-work roll interface and vibration in the Hot Roughing Mill and Five Stand Cold Mills. A study of the vibration characteristics of the hot roughing mill (which includes linear vibration and torsional vibration) as well as vibration modes due to coupling of the horizontal roughing mill and the vertical edging mill, has been completed. The Australian Research Council and BHP Steel SPPD is sponsoring an Australian Postgraduate Research Award (Industry

(APRAI) to study the dynamics at the strip-roll interface in the roughing mill, which is relevant to mill shuddering and chatter. The problem of asymmetrical rolling arising from vibration and self-excited vibration has also been investigated. Two PhD and one final-year student have been involved in this project.

Another collaborative research project with BHP Steel SPPD is on friction and wear in rolling mills. A universal friction and wear test rig has been built to simulate different wear modes in an industrial environment. Tests are being made to determine the friction and wear characteristics of hot steel (at 1100° C), tin plate and ceramic coating of the plate mill housing liners. Mechanical properties of hot steels have been measured and used in the study of rolling mill vibration.

Tribology

In an endeavour to provide a tool for condition monitoring in the power industry, a computer simulation has been carried out to determine the vibration characteristics and the stability of steam turbine bearings in power stations. Results indicated a need to correlate the simulation with experimental results. A journal bearing of about one quarter the size of a typical steam turbine bearing has been successfully tested in a fully instrumented journal-bearing test rig equipped with transducers to measure oil film thickness, pressure, friction, shaft displacements and temperatures. The results have correlated very well with the computer simulation. Two PhD students are currently working on the project, which is supported by Pacific Power NSW and Caltex.

In another area of tribology research, an experimental test rig has been successfully commissioned to test different types of thrust bearings at high speeds, up to 150m/s. Parameters on the rig are monitored by sensors which provide measurements of bearing gap, pressure, friction, temperature and fluid velocity. Fluid velocities are obtained by miniature Laser Doppler Anemometer using laser diodes, optical fibre and

miniature optics. Also developed is a low-cost miniature laser diode probe, which can measure velocities in journal bearing gap of 0.49mm, and which we believe to be a world 'first'. The experiments are being carried out on bearings operated in the superlaminar regime, and the results have correlated well with our new theory. It was found that existing design theories on turbulent bearings are inaccurate, and a new design theory for high speed bearings has been proposed. This project is supported by an ARC grant.

New thrust and journal bearings with high performance have been developed in Wollongong. The bearings were tested on the high-speed test rigs described above, and the design data for them are being generated. Test results have correlated well with the computer simulation and the bearings have shown better load-carrying capacity and lower friction than available from conventional bearings.

Cavitation and Bubble Dynamics and Flow Transients

The project 'Control valves damage induced by cavitation' by Dr W-K Soh is being carried out in collaboration with Pacific Power (Electricity Commission NSW).

The study places emphasis on damage to valves in industrial service as a result of cavitation. It examines the operating characteristics and design features of the valves used in the power-generation industry and links them to the damage features observed as a result of cavitation. Chief among the strategies to minimise cavitation damage is a study of the pressure reduction chamber formerly used in the power industry. Flow patterns in this device have been analysed. Its ability to operate without cavitation, while maintaining constant boiler feed pump flow, have been reported.

On the topic of bubble dynamics, the project 'Scale model study of under water explosion' is of defence significance. It is supported by the Material Research Lab of DSTO (\$171,000 for



Dr Wee-King Soh (right) and Dr Ching-Fu Yu examine the electrodes for the simulation of an underwater explosion

1990 to 1993). The main objective of the project is to carry out an experimental scale-model study of bubbles produced by an underwater explosion. The deformation of an explosion bubble, under the influence of various geometric configurations of free surface and rigid wall boundaries, will be quantified so that the impulse on these boundaries and the speed of the jet generated by the bubble may be estimated. High-speed cinematography is used to capture images of a simulated explosion bubble in a decompression water tank. Image data are analysed using an image processing technique developed in conjunction with the Material Research Lab.

Another aspect of bubble dynamics is being studied in the project 'The dy-

namics of cavity bubble' which is funded by the Australian Research Council (ARC), 1991 \$14,500, 1992 \$8,620.

The study of flows around a cavity bubble is important in the understanding of cavitations and underwater explosions phenomena. Models provided so far have not been able to explain many aspects of the observed phenomena. Study on the dynamics of a cavitation bubble near a compliant surface has demonstrated that cavitation damage can be reduced, or even prevented, by coating surfaces with compliant materials.

Jet Ejector Development

Important progress has been made in the development of the Jet Ejector Re-

frigeration System. A grant of \$10,000 was obtained from Nippon Oil Company (Japan) to support the construction of experimental facilities. An experimental rig was constructed and initial testing of an ejector prototype undertaken. It is now completed. This work was carried out by a Masters student, Mr M Kanashige, and is being continued by Mr H S Bidgoli, a PhD student. The next stages in development include conversion of the rig from the use of CFC 12 as the working fluid to the ozone-benign replacement, HFC 134a. The principal application of this technology is considered to lie in transport engineering. It is hoped that a practical demonstration of the ejector system in the Departmental Nissan Pintara will be completed in 1993.

Initial findings on the improvement in performance of air collectors using artificially roughened ducts were presented at the Fourth International Symposium on Transport Phenomena – 'Heat and Mass Transfer', Sydney, in July 1991. Dr Cooper conducted further theoretical investigation while on sabbatical at the University of Roorkee (India), working with the Solar Energy research group in the Department of Mechanical and Industrial Engineering. A computer-based design tool was developed for the optimisation of roughness geometry for a given solar air collector.

An ARC Small Grant was won by Dr Cooper for research on naturally ventilated spaces (\$6,896 for 1992 and \$6,000 in 1993). In addition, Dr Cooper spent the major part of his study leave in Autumn Semester at the Department of Applied Mathematics and Theoretical Physics, in the University of Cambridge (UK), studying this topic. Two PhD students are due to start research in this area in 1993.

Environment

In a project on mine safety, discrete element modelling for the inrush of ground water to caved mine workings has involved four different modules in-

corporating mine-roof collapse mechanism, numerical calculation of directional permeability, time-dependent flow models and finally calculating flow to a mine. Many physical aspects of the mine water in-flow problem have been evaluated.

On environment and health issues, especially Legionella disease, a project on the ozone system is progressing well. Improved efficiency for ozone generation and mass transfer of ozone into water was achieved by the design of a close-circuit system. An on-site test to evaluate the Legionella disinfection performance of the system is planned for 1993. A mathematical model for the mass transfer and disinfection of ozone is being constructed. Analysis has brought further understanding of the system by identifying two relevant coefficients which play dominant roles in the disinfection process of ozone: the total oxidation rate constant and the Henry's law constant for each biological species.

Intelligent Manufacturing System

Research activities under the 'Advanced Manufacturing Technology' umbrella into 'Japanese' manufacturing and quality techniques continue. Professor Arndt was invited by the Japanese IMS (Intelligent Manufacturing System) Promotion Centre to present a paper on Intelligent Manufacturing Systems in Tokyo in March, as part of the First International Symposium on IMS. He is also the national academic representative on the five-man Australian delegation of the International Steering Committee for the Global IMS program, involved in world-wide collaborative manufacturing research spanning up to 12 years. Together with Professor C D Cook, he has been instrumental in putting together the application for a third round CRC in Intelligent Manufacturing Systems and Technologies. This, if successful, will be the 'Australian

flagship' for the international IMS project mentioned above.

Robotics

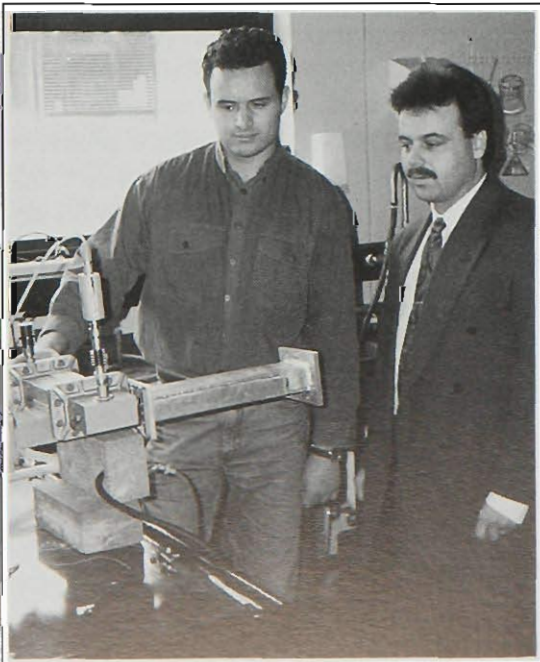
Dynamic Load Carrying Capacity for a robot manipulator based on a flexible-arm model with high speeds and high tracking precision is formulated in a project on robotics. A computational procedure for determining the maximum allowable load subject to constraints is applied on the basis of the theoretical model. A symbolic language package Mathematica has been used for automatic simplification, numerical solution and graphical representation in a PC-based user-friendly environment. An experimental procedure has been established to confirm theoretical results for verifications of the trajectories and control of the manipulator. Eight journal and conference papers from this project have been prepared for publication between 1991 and 1992.

Application of AI techniques in robot application is being considered in the project 'Design and Manufacture of an Intelligent Six-leg Crawling Robot'. The project promotes research on a robot proper, and may have potential applications – such as safety inspection – in the nuclear industry.

Welding and Joining of Materials

A new welding process researched by Dr E Siores since 1989 has led to a pioneering development of a novel technique for joining materials using microwave energy. The work led to a prototype development capable of joining a range of polymer materials. Once the concept was fully proved in 1990 development work to automate the process began in 1991. This was successfully completed with the assistance of the PhD student, Mr Do Rego. Since then R&D work concentrated on assessing the technique's potential in joining metals of only relatively small thicknesses, as well as its potential in joining ceramic materials. Benefits include effectiveness in bond quality and process efficiency. The latter is seen in the light of low equipment capital, pro-

Dr E Siores and Mr Do Rego, a PhD student, are making a study of a novel means of joining materials through the use of microwave energy



duction and maintenance costs associated with the process which, it is believed, will offer capabilities equivalent to those of laser welding.

Further developments in 1993 by Dr Siores, within the recently established Cooperative Research Centre (CRC) for Materials Welding and Joining, will be in collaboration with Dr D Bradhurst from the Microwave Applications Research Centre (MARC). Dr Siores has gained two awards: the Ramsey-Moon Award for the best Australian paper in the area of Materials Welding and Joining, and the AINDT Award for the best Australian paper in the area of Non-Destructive Testing and Evaluation.

Applications of Fuzzy Logic Theory

The significant feature of fuzzy set/logic lies in its simulation of human thinking by incorporating the vagueness inherent in all physical systems. So far, fuzzy set theory has found many successful applications with significant economic benefits. For example, in Japan, fuzzy-based new products ranging from the auto-focusing camera, vacuum cleaner, washing machine and air conditioner to vehicle auto-transmission are flooding the country. In industrial process, fuzzy set has been applied into quality control, industrial process control, scheduling and dispatching and inventory control. The aim of the project 'Fuzzy Logic Control and Fuzzy-set Theory in Industrial Application' is to apply fuzzy theory in industry. The following two applications have been studied by using fuzzy set/logic methods.

- Fuzzy Set-based Optimal Assignment of Metallurgical Grade for Steel Production. This research project will be supported by a BHP Steel commitment to provide support (\$5,000 in cash and \$20,000 in kind) for an ARC APRA (industry) scholarship.
- Intelligent Fuzzy Logic Adaptive Control of Small-hole Deep Drilling is a critical issue and in high demand from manufacturing industry. For example, a division of Metal Manufacturing (MM) of Australia, MM Metals in Port Kembla has a special product used in



Dr Paul Cooper (right) and Hassan Sharifi Bidgoli make adjustments to the Vapour Jet Refrigeration System. Work is under way to transfer technology developed in the laboratory rig on the left to car air-conditioning systems. This would drastically reduce the fuel consumption of conventional systems

motor-vehicle air-conditioning systems. About 40 small holes (at least 25mm deep) need to be drilled in the part. Because of the problem with small-diameter deep hole drilling, this key component has to be imported. A solution would benefit many companies.

Machining and Technology Transfer

Fully automated manufacturing requires reliable techniques for real time monitoring and diagnosis of the machining process and operating conditions of the critical components of machine tools. Parameters such as cutting forces and spindle motor torque have been used for this purpose. However, the process and machine-condition monitoring by using the acoustic emission (AE) technique will enable better diagnosis and process control. Currently a system is being designed and developed for simultaneous acquisition of forces and AE signals generated at the tool-chip interface. The composite AE signals will be analysed to extract the useful data concerning tool chatter,

CNC machine-tool vibrations and spindle-bearing condition. The results obtained will be used in the real time monitoring and diagnosis of the processes and machine tools in the factories of the future.

In a project together with tool manufacturers, to improve machining performance, experiments of tip-wear characteristics for internal threading operation using various tool tips from Iscar and Sandvik have been carried out. Significant improvement on the life of the cutting tip has been achieved. As a result, Sandvik has shown serious interests in the testing of various tips.

In the application of manufacturing technology to agriculture, the project on an automated device to harvest asparagus has been relatively successful. Controlled by fast response Famuc PLC equipment and very fast sensors and actuators, the device is the only one available in Australia to harvest asparagus. Many can manufacturers are interested in the project.

Members: Dr P Davy, Dr S Ghahreman, Dr C Gulati, Dr K Russell, Dr R Sparks (all from the Department of Mathematics) and Associate Professor Tran Van Hoa (Economics).

THE APPLIED Statistics Research Group is continuing to produce fundamental and applied research that is relevant and important in several disciplines. Part of this effort is the Statistical Consulting Service, which contributes greatly to the quantitative research work carried out in this University. In the past year there was significant change in the membership of the group, which has refined its focus and been strengthened by new appointments.

Research Undertaken

Beach Dynamics

Storm frequencies and intensities for the local coastal area from 1965 have been extended forward to the end of 1991. Further analysis of each of these time series confirmed the previous results that the storm frequency measure has a strong biennial cycle, while the storm intensities show a classical annual cycle. Corresponding data for Gabo Island to the south are being measured so that comparisons may be made with the 20-month coupling already found for the local area.

Epidemiology

David Griffiths and David Steel have collaborated on development of a proposal for a large cardiovascular risk study. Joint work by David Griffiths with the Faculty of Health and Behavioural Sciences is completed to the stage of preliminary reports on asthma prevalence and morbidity in the Illawarra and a cardiovascular risk factor study in two small populations.

Material Processing

Yan-Hui Yang and Pamela Davy have been developing statistical methods for analysing particulate materials. They have discussed their work with Mt Isa Mines Ltd, who are interested in assessing the liberation of ores at various stages of processing.

Mathematical Statistics

A standard approach in statistical modelling is to assume a probability distribution for the random part of the model and construct the likelihood. The parameters of the distribution are then estimated, the model assessed, and if valid, the model can be used predictively. John Rayner is continuing to develop his smooth methods for the assessment of models. Yan-Xia Lin is working on the quasi-likelihood method, an essentially new approach that is appropriate if the distributional assumption is tenuous.

Surveys and Design

Statistics calculated from group level data, such as data for spatial units, can be very different from those calculated from person or household level data. David Steel had developed a general theoretical framework for making statistical inferences from such data and a systematic way of investigating and adjusting for the aggregation effects that arise. In collaboration with David Holt and Neil Wrigley at the University of Southampton, David Steel is undertaking an analysis of aggregation effects in UK population census data. This will be the first large scale application of his methods and will provide a detailed evaluation of their effectiveness.

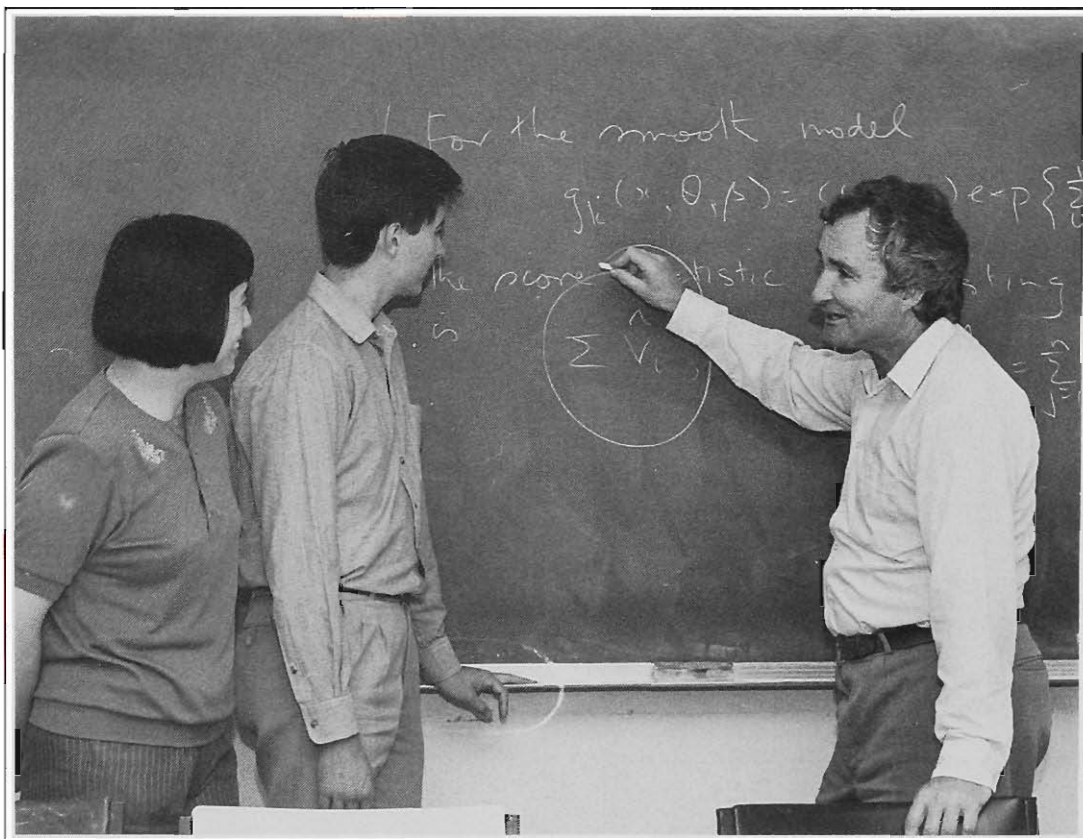
Performing such an analysis for a large number of socio-demographic variables opens the way to identifying the variables that account for most of the differences between individual and group-level analyses. With such information it will be possible to make general recommendations on adjusting analyses based on spatial data from the census or other data sources to give improved estimates of individual level relationships.

The analysis would also reveal factors and variables influencing the group structure which would be of substantive interest. The increasing number of Geographic Information Systems will add significantly to the already large amount of group level data available to researchers, business and industry. This research will have implications for any analysis using data provided by such systems.

Statistical Consulting Service

The Statistical Consulting Service provides assistance in statistical matters to postgraduate students and academic staff pursuing research investigations. While at times this may be as simple as advising on the choice of appropriate computer software, or the best way to present a graph, it generally involves a significant contribution to the planning of the investigation and/or analysis of the data collected by the researcher. Much of the quantitative research work

Yan-Xia Lin, Francis Crumplin and John Rayner use the blackboard to discuss a technical point arising in their statistical modelling project



carried out in this University is heavily dependent upon the contribution of the Statistical Consulting Service.

A wide variety of topics have been dealt with in the past year. In the Faculty of Education, researchers have consulted the Service on such matters as a comparison of different methods of improving the reading skills of disadvantaged children, and an examination of the effects that different types of music have on viewers' responses to television commercials. A researcher from Engineering sought assistance with the analysis of noise data collected from intersections; a second was provided with an explanation of statistical techniques in a published research paper. One researcher from Science has obtained assistance with the evaluation of data from rats fed one of three diets; because her data were not suitable for standard

techniques of analysis, different methods had to be devised. Academics from Commerce have consulted on a comparison of data collected before and after a method of teaching was carried out, and on the factor analysis of data on the meanings attributed by students to various technical terms.

Two researchers from the Faculty of Health and Behavioural Sciences were awarded PhDs at the October Graduation ceremony for theses with considerable input from the Statistical Consulting Service. They were Michael Martin (Department of Human Movement Science), for a thesis entitled 'Effect of Self-Monitoring Strategies on Motor Skill Performance', and Jeffery Wragg (Department of Psychology), whose thesis was 'The Development and Evaluation of a Model of Drug Education for Adolescents'.

ASIA-PACIFIC DEVELOPMENT STUDIES

Co-ordinators: Dr Melanie Beresford (Department of History and Politics), tel. 21 3669; Dr Dennis O'Brien (Department of Economics), tel. 21 3654

Member: Dr H Beran (Philosophy), Dr E Booth (Education), Associate Professor D Chaudhri, Dr K Chowdhury, Dr A Levy, Dr M Metwally, Dr N Perera (all from Economics), Mr A Naughton (Management), Dr A Vickers and Professor E Wolfers (History & Politics).

THE PROGRAM, now in its third year, involves researchers in three faculties and five departments. In 1992 Drs K Chowdhury and N Perera from the Department of Economics joined the Program bringing the number of researchers to 11.

Kurshed Chowdhury joined the project being undertaken jointly by D P Chaudhri, Amnon Levy and Dennis O'Brien on Cereal Trade and Market Integration in the Asia-Australia region. This project aims at studying the improvements in resource allocation, economic welfare, food security and price stability which could be obtained by regional cooperation and integration of input and product markets. The implications for Australia are enormous since we so far have only a small share of the expanding intra-regional trade.

An offshoot of the cereal trade project has been the establishment in 1991 of a large electronic data base. This has since been expanded to include a wide range of statistics on 11 countries in the Asia-Pacific region and is expected to form a major resource for researchers working on this area in future. D P Chaudhri has been largely responsible for initiating this project.

Associate Professor Chaudhri was also invited to deliver the V V Giri Memorial Lecture of the Indian Society of Labour Economics at Hyderabad in December 1991.

Melanie Beresford spent six months in Vietnam and France working on aspects of the Vietnamese industrialisation process with funding from the Australian Research Council (ARC) Small Grants Scheme. She has established research links with the Institute of World



Program co-ordinators of the Asia-Pacific Development Studies Program, Dr Dennis O'Brien and Dr Melanie Beresford

Economy in Hanoi and with the History Department of the University of Hanoi, both of which have potential for further exchanges with the University of Wollongong. She was also an invited speaker at the North-west Regional Consortium of South-east Asian Studies Conference in Vancouver.

Tony Naughton's Asian capital markets project has attracted support from institutions as far apart as the Chicago Board of Trade and Yung Shin Securities (Taiwan). He has been awarded \$90,000 by Department of Education and Employment Training to develop further academic links with Taiwan. In July 1992 he presented a paper to the 4th Pacific Basin Finance Conference in Hong Kong.

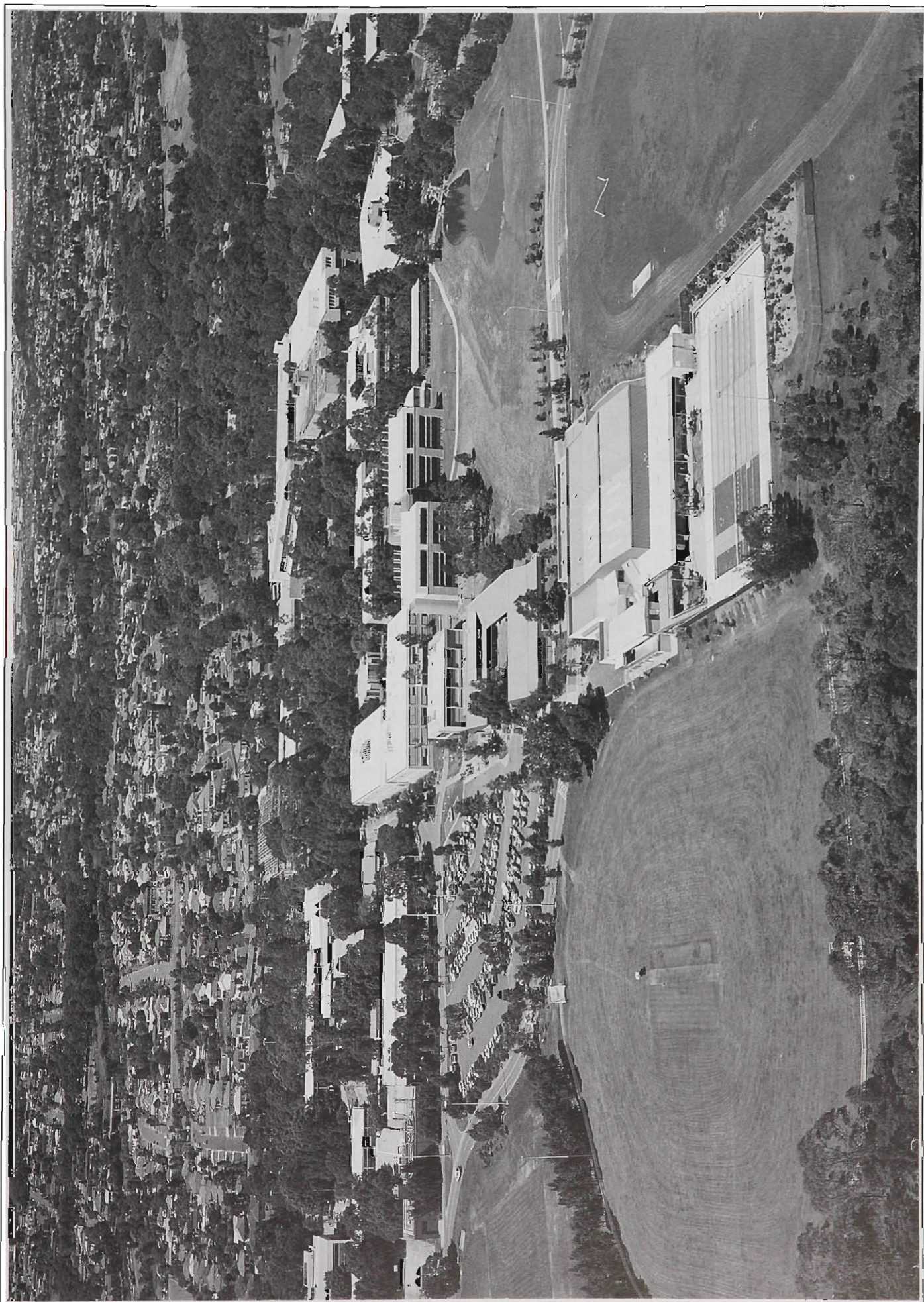
Dennis O'Brien's project on rural development in Indonesia (funded by the Australian Centre for International Agricultural Research) is well advanced. During 1992 Mr Andoko, economist and statistician from Centre for Agro-socio Economic Research (CASER), the Indonesian collaborative institution, spent three months working with staff and postgraduate students on analysis of the Indonesian farm survey data for the final stages of research on income and

employment. Later in the year, the director of CASER, Dr Effendi Pasandaran, also visited the program.

Edward Wolfers completed work on editing the memoirs of Papua New Guinea's first ambassador to the UN and on interpretation of the PNG constitution in collaboration with Henry Eyre. His current research on relations between South-western Pacific countries and South-east Asia resulted in a paper presented to the 3rd Indonesia-South-west Pacific Regional Conference in Ujung Pandang.

A new initiative in 1992 has been the development of joint research between Moktar Metwally, Dennis O'Brien and Nelson Perera on the impact of growth in the Australian economy on the economies of our Asian-Pacific neighbours.

A regular seminar series has been a feature of the program, bringing together individuals from different disciplines and providing access for the wider university community to research on the Asia-Pacific region in several disciplinary areas. Involving all members of the Program, a workshop was organised in August on Australia's foreign aid budget.



The University of Wollongong campus – a bird's-eye view

AUSTRALIAN FLORA AND FAUNA

Co-ordinators: Associate Professor Rob Whelan, tel. 21 3442 and Associate Professor Tony Hulbert, tel. 21 3437 (both from the Department of Biology)

Members: Dr D Ayre, Dr A Davis, Dr D Skelly, Dr C Vaughton (all from Biology) and Ms A O'Neill (Geography).

DURING 1991-92, the Australian Flora and Fauna Research Program matured into one of the strongest research groups in this area in Australia and has developed a strong international profile. The program currently includes seven academic staff, one associate in industry, two post-doctoral fellows, and over 20 research students, with a range of research interests including marine biology, ecology, animal behaviour, genetics, evolution, physiology, biogeography and environmental management.

Five staff in the program secured research funding from the Australian Research Council to start new projects in 1992. Some of these projects are

described briefly below. In addition, Dr Glenda Vaughton (PhD, University of New England) joined the program in 1992 as a postdoctoral fellow. Dr Vaughton won one of the three Rothman's Fellowships awarded for 1992, to enable her to examine the ecology and conservation biology of a threatened plant species, *Grevillea barklyana*, in south-eastern Australia.

International connections

In developing an international profile, the Program has funded a Postdoctoral Fellowship. Dr David Skelly, a PhD graduate from the University of Michigan, was appointed and he will be bringing with him expertise in the ecology of amphibians. Results from his doctoral work on tadpoles indicate that animals may be faced with a 'trade-off' between growth and risk of predation - increased time spent feeding increases the likelihood of being eaten by a predator. In the Illawarra, David will use the high local diversity of treefrog species to examine the evolution of

feeding activity in different kinds of aquatic habitats.

The Program also supported a visit by Dr Martin Brand (Cambridge University), enabling Tony Hulbert to build on a collaboration forged in 1990 with a research project on the evolution of warm bloodedness in mammals (see below). Rob Whelan presented a paper at the American Ecological Society based on collaborative work with David Ayre on pollination ecology and genetics of *Grevillea barklyana*, a threatened species in the Jervis Bay area. An 18-month visit by Professor Zeng Liangzhong (Fujian University, PR China) finished in May, with Professor Zeng and Rob Whelan completing several studies on revegetation of disturbed and industrial land for BHP and the Water Board.

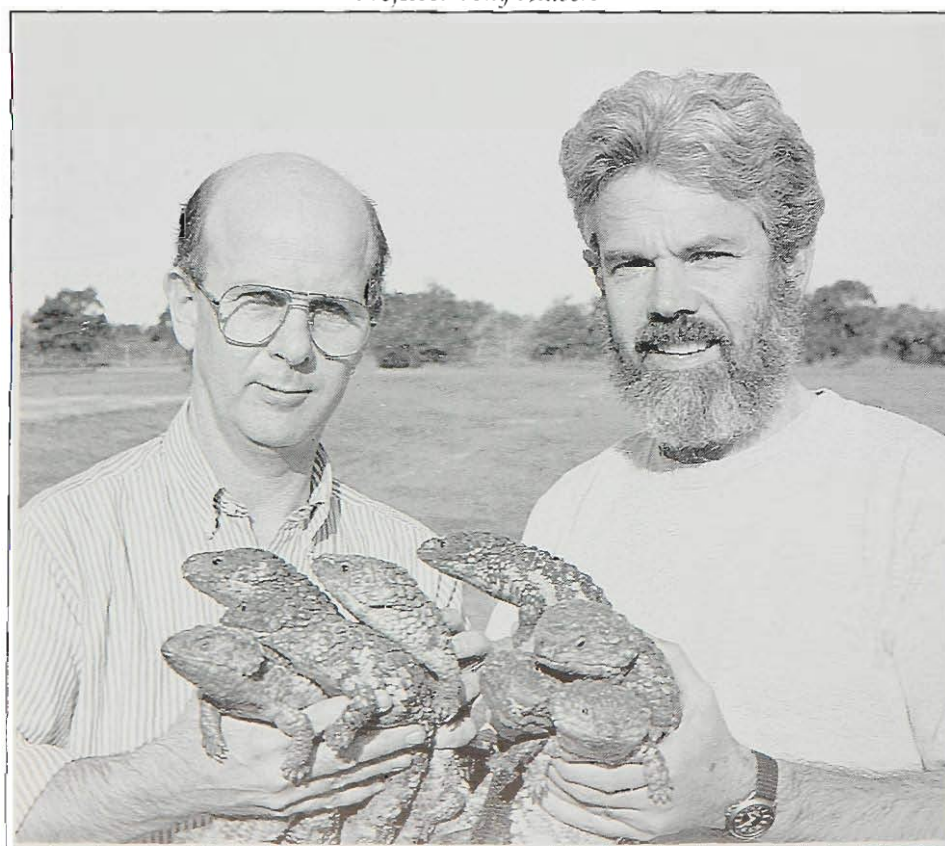
Several PhD candidates associated with the program have come from overseas. Patrice Couture (Canada) and Tahira Rana (Pakistan) are working with Tony Hulbert on the evolution of endothermy in mammals, and Miles Hoskin (UK) is working with David Ayre and Andy Davis on the evolutionary consequences of different patterns of dispersal in whelks. In addition, Dr Jennie Chaplin completed her PhD at the end of 1991 and won a Canadian postdoctoral fellowship to work at the University of Guelph.

Reports on projects

Insect behaviour

Australia has a rich and interesting cricket fauna, with many species still unnamed. Some crickets swarm like locusts and cause similar damage in pastures. They are perhaps the most studied group of insects, though much of this work has been in the laboratory. Dr Jim Campbell's work is based in the field, and therefore complements overseas laboratory research. The main thrust of the investigation is to determine ways in which temporal patterns of migration and acoustical signalling influence the spacing of territorial males and their potential for reproductive success.

Co-ordinators of the Program, Associate Professor Rob Whelan and Associate Professor Tony Hulbert



After 27 years as a member of the University, and a foundation member of this Research Program, Dr Jim Campbell retired from the Biology Department at the end of 1992, but he will continue his research and association with the Program. Some of his analyses are textbook examples of the evaluation of spatial pattern and one of his computer programs is featured in a recent text, *Ecological Methodology*, and has been named 'Campbell'.

Marine ecology

There is a dearth of information about the ways in which marine invertebrates reproduce and the distances over which they disperse. This information is fundamental to an understanding of the design and implementation of conservation zones – a number of which have recently been mooted for the South Coast of New South Wales. David Ayre and Andy Davis have initiated a project, funded by the Australian Research Council (ARC) for 1992-94, examining dispersal in ascidians ('sea squirts'), a group of animals which are common in rocky subtidal areas. Some members of this group are generally assumed to disperse large distances (100 - 1000 km) while others may disperse less than 10m. This project will infer dispersal distances in a number of ascidian species, using gel electrophoresis, and will involve setting up a series of breeding and transplant experiments.

David Ayre and Dr Terry Hughes (James Cook University) have begun a large-scale study, also funded by ARC, of the ecology and population genetics of corals on the Great Barrier Reef. This project will combine genetic surveys and long-term demographic studies of corals in order to understand the evolution of their life histories. The findings will also contribute to management of the Great Barrier Reef.

Pollination ecology

Rob Whelan has started work on a new ARC-funded project to examine reproduction in a range of native plant species – including grevilleas, banksias and two waratah species. The study aims to explain the very low levels of



Dr Glenda Vaughton and Dr David Skelly – new postdoctoral fellows with the Program

reproductive success in these species, by experimentally examining soil fertility, pollination effectiveness and competition among fruits for limited resources within the plant.

As mentioned earlier, collaborative work on pollination ecology and ecological genetics of native plants is being expanded. *Grevillea/barklyana*, a threatened shrub species in the family Proteaceae, has been the focus of research by Drs Rob Whelan and David Ayre over several years. Now Dr Glenda Vaughton, one of the new Postdoctoral Fellows, will extend investigations into the reproductive ecology and genetics of this species, which occurs in small, isolated populations in the Jervis Bay region. Poor recruitment and increased inbreeding in small populations is a general concern in conservation biology. Field and greenhouse studies are under way to examine the influence of inbreeding in *G. barklyana*. In addition, the genetic variation within and between populations will be screened, using electrophoretic techniques, and will be related to population size and degree of disturbance. This information is important in designing suitable management strategies for *G. barklyana*, and will be applicable to other similar plant species.

Evolution of warm-bloodedness in mammals

Australian reptiles have been critical in research into the evolution of endothermy (warm-bloodedness). Associate Professor Tony Hulbert's research in this area has received international attention, and Tony has been invited to organise a symposium on the work done at Wollongong for the 1994 scientific meetings of the American Physiology Society. One important finding is that the cell membranes of warm-blooded mammals are considerably more polyunsaturated than those of cold-blooded reptiles. Research by Tony, Patrice Couture (PhD student) and Dr Martin Brand (Cambridge University) shows that the low polyunsaturated fat content of the reptilian cell membranes means that they are much less 'leaky' than the membranes of warm-blooded mammals. This means the cells have to work less and therefore create less heat than mammalian cells, indicating a fundamental difference between cold-blooded and warm-blooded animals. Tahira Rana (PhD student) has recently joined the project to examine in more detail the membrane composition of mammal and reptile cells. She will especially concentrate her studies on the well-known shingleback lizard. This work on membrane lipids has led to a number of more applied projects examining the effects of dietary lipids on animal function.

BIOACTIVE MOLECULES

Co-ordinator: Professor Leon Kane-Maguire (Department of Chemistry), tel. 21 3509

Members: Professor J Bremner, Associate Professor J Ellis, Dr G Mockler, Dr W Price, Dr S Pyne, Dr S Ralph, Dr M Sheil, Associate Professor R Truscott, Dr G Wickham (all from Chemistry) and Associate Professor R Lilley (Biology).

THE BIOACTIVE Molecules Program brings together overlapping research interests of nine academic staff from the Departments of Chemistry and Biology in the area of synthesis, characterisation and testing of biologically and pharmacologically active molecules. Central to much of this work is the elucidation at the molecular level of the physiological action of such molecules.

A major impetus during 1992 was the arrival and establishment of Professor John Bremner's research group in medicinal chemistry, complementing our existing strength in biological chemistry. Another major development has been the establishment of strong links with the Biomedicine and Health Group at Australian Nuclear Science & Technology Organisation (ANSTO), involving a joint Australian Postgraduate Research Award (Industry) (APRAI) PhD Scholarship and a Post-doctoral appointment. Dr Garry Mockler, an expert in co-ordination complex models for large proteins, also joined the Program adding to our current expertise in protein structure and reactivity.

In addition to the academic staff mentioned, there are now 26 other research personnel from Chemistry and Biology directly involved with the Program. These include 14 PhD students, four MSc students, four Honours students and two Post-doctoral Fellows, giving an overall group of 35 researchers. The Program continues to attract substantial external research funding, totalling some \$580,000 in 1992, including \$407,000 from the Australian Research Council.

A highlight of the year was the acquisition in March of a new state-of-the-art Triple Quadrupole Mass Spectrometer (value \$450,000, largely funded externally). This instrument incorporates an electrospray source, a very recent development which has caused a revolution in the ability to characterise large macromolecules such as proteins by mass spectrometry. Also commissioned, for use by members of both the Bioactive Molecules Program and the Biological Macromolecules Program, was a modern computer-based *molecular modelling facility* (IRIS Indigo computer). These two new units, together with the 400 MHz NMR spectrometer, provide a very powerful, world-class facility for the characterisation of bioactive molecules and the elucidation of their mode of action at the molecular level.

During the year Program members were invited to give several main lec-

tures at international and national conferences, including a plenary lecture by Professor John Bremner at the 7th Asian Symposium on Medicinal Plants.

There are two major and complementary research strands in the Program. The first is concerned with the design, synthesis and evaluation of bioactive compounds, the second with the structural elucidation and analysis of such compounds from natural sources. Developments in some of the major areas are summarised below.

Heterocyclic bioactive compounds

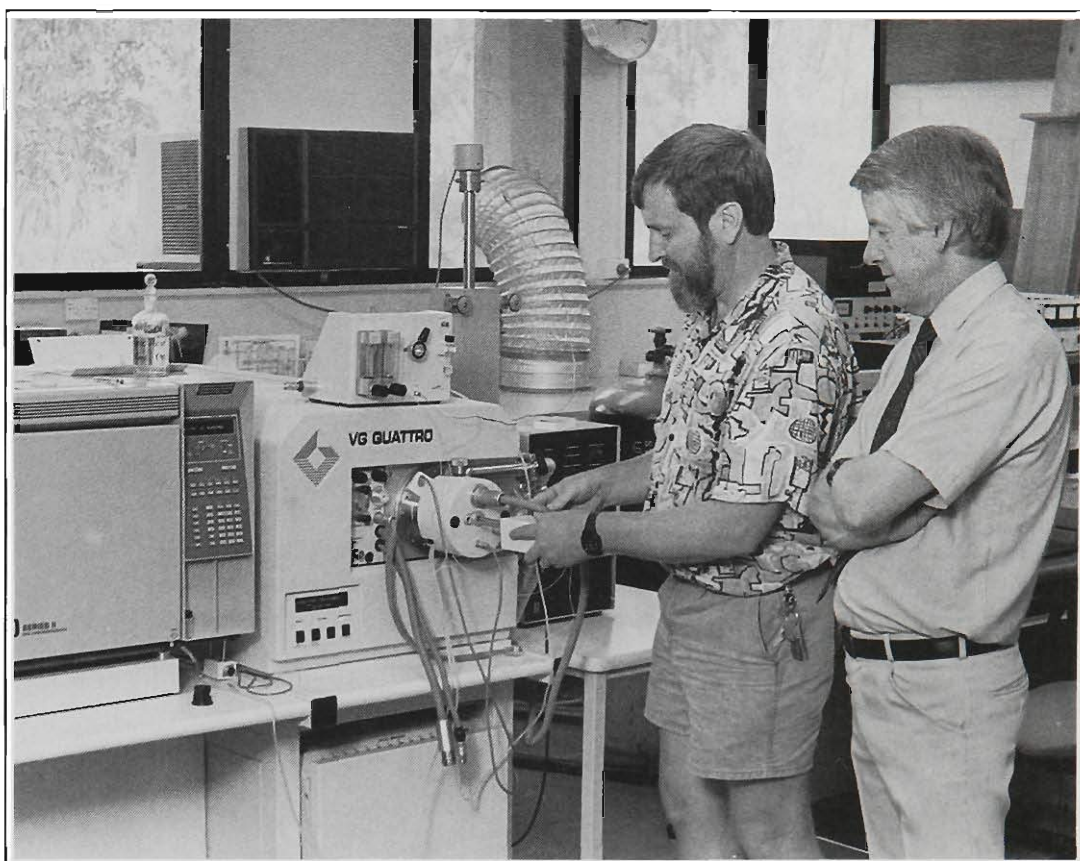
There is a need for new compounds as medicinal agents which have high levels of useful activity with few or no adverse effects. Professor John Bremner's medicinal chemistry group is involved in the design, synthesis and pharmacological evaluation of novel lead compounds which could be developed as potential anti-depressants, antipsychotics and anti-hypertensive agents. For example, they have recently confirmed a new type of uptake inhibitor for 5-hydroxytryptamine, and more extensive structure-property and mode-of-actions studies are being pursued. These compounds are potential anti-depressant agents.

Asymmetric Synthesis of pharmaceuticals

The majority of drugs have two mirror-image forms which are non-superimposable (in the same way as our right and left hands). Frequently only one mirror form of the drug has the desired biological activity, while the other is either inactive or toxic, e.g., the morning sickness drug Thalidomide.

Recent regulations by the Food and Drug Administration now require pharmaceutical companies to produce and test such drugs in each separate pure form. A research group under Professor Leon Kane-Maguire and Dr Stephen Pyne in the Department of Chemistry has been successful in developing novel and efficient methods for synthesising such drugs in only the one desired form, using organometallic

Watched by Professor Leon Kane-Maguire, Mr Larry Hick (STO) inserts a protein sample into the Department of Chemistry's new \$500,000 Mass Spectrometer. With its capacity to measure the mass of large biomolecules, this state-of-the-art instrument provides a major advance in characterisation of such compounds



and sulfur reagents. For example, a highly stereoselective route has recently been found to the anti-hypertensive drug Perindopril in a project supported by Johnston and Johnston.

Radiopharmaceuticals

Pharmaceutical agents labelled specially with certain radioisotopes are of continuing and increasing importance in the diagnosis of certain medical conditions, e.g., heart disease. In collaboration with the Biomedicine and Health Program at ANSTO, groups in Chemistry led by Professor J Bremner, Professor Leon Kane-Maguire and Dr Stephen Pyne are developing novel synthetic routes for the preparation of radiolabelled pharmaceuticals.

Bioactive metabolites from marine organisms and plants

Related and collaborative research projects are being carried out by staff from both the Departments of Chemistry and Biology investigating bioactive metabolites from marine and plant organisms.

A group involving collaboration between

Professor Helen Garnett of Biology and Drs Margaret Sheil and Stephen Pyne of Chemistry has made a significant advance in the chemical detection of dieback and greening, serious diseases for the citrus industry. Using the newly acquired mass spectrometer they have developed a highly sensitive technique for the quantification of the chemical marker, gentisic acid, associated with these diseases.

In collaboration with co-workers in South-east Asia, Professor John Bremner and Associate Professor Roger Truscott in Chemistry have also been investigating the isolation, characterisation and assessment of the properties of bioactive compounds from medicinal plants. Many of these are of tropical forest origin, and a particular interest is the isolation of new potent agents for the treatment of malaria.

Associate Professor Ross Lilley in Biology is involved in a related project aimed at the aquaculture of species of the marine organism *Dunaliella* to produce commercial biochemicals. Recent biochemical studies by his group have provided considerable evidence con-

cerning the production of glycerol by this salt-resistant organism.

Analysis of environmental toxins

The algal metabolites, geosmin and methylisoborneol, are largely responsible for the musty odour and toxicity in surface waters. Associate Professor John Ellis' group in Chemistry has succeeded in developing new improved methods for the analysis of these odorous algal metabolites using mass spectrometry. This latter technique is also being used by Dr Margaret Sheil and Dr William Price in characterising the humic substances in soil, in a project aimed at exploring the transport of pesticides and other toxins in agricultural land. As part of an International Development Program (IDP)-sponsored project on Environmental Protection with Shenyang University, China, John Ellis is also examining the efficacy of zeolite materials for the removal of toxic organic chemicals, including potentially carcinogenic polycyclic aromatic hydrocarbons, from industrial and process waters.

BIOLOGICAL MACROMOLECULES

Co-ordinator: Associate Professor Ross Lilley (Department of Biology), tel. 21 3431



Associate Professor Roger Truscott purifying components from the lens part of the research program on senile cataract. Senile cataract is the major cause of blindness world wide and members of the ACRF combine in an effort to find the cause of this disease. The ACRF is the leading cataract research group in Australia

Members: Dr S Armstrong, Dr J Carver, Associate Professor R Truscott (all from Chemistry), Dr M Baker, Associate Professor E Steele, Dr M Walker, Dr S Woodruffe (all from Biology).

LIVING organisms are constructed from a set of large, complex and extremely diverse molecules known collectively as macromolecules. The biologically important macromolecules are proteins, nucleic acids, lipids and polysaccharides. Most problems in medicine and agriculture hinge ultimately on the synthesis, structure and/or function of particular macromolecules. In this Program, the structures and functions of specific macromolecules are

being investigated in relation to a number of significant biological problems. More than 30 staff and research students from the Departments of Biology and Chemistry are engaged in this series of related research projects.

The major problems in studying macromolecules are, first, the difficulty of detecting and purifying a specific macromolecule, which may be present in only minute amounts among a complex mixture of vast numbers of other types of macromolecules. Secondly, it is often necessary to measure slight changes in the structure of one small part of a specific macromolecule. Slight changes in structure can often cause large shifts in the biological activity of protein or DNA macromolecules, and these changes can be central to the resolution of important

functions or problems. These problems in detection, purification and structure determination are being addressed by the acquisition and development of a suite of 'state of the art' equipment available to all members of the program.

Macromolecules and Disease

Eyesight in the elderly – the mechanism of cataract formation

The formation of cataracts in the eye, with its associated loss of vision, is a common problem in elderly people that can at present be rectified only by surgery. Dr Sharon Armstrong, Dr John Carver and Associate Professor Roger Truscott are engaged in research focused on finding the cause of human senile cataract. To do this they are examining proteins from eye lens with cataract to



⚠ DANGER ⚠
STRONG MAGNETIC FIELD

Persons with pacemakers or metal prosthetics must stay at least 4.5 meters (15 feet) away from the magnet because of the risk of serious injury.

Keep all tools, equipment, or personal items containing steel, iron or other magnetic materials at least 2 meters (6 feet) away from the magnet. Magnetic items can suddenly fly towards the magnet and cause serious damage or personal injury.

Do not use iron or steel doors during servicing. Magnetic doors can seriously damage the magnet. Use only non-magnetic stainless steel doors.

Dr John Carver tuning the magnet of the 400 MHz nuclear magnetic resonance (NMR) spectrometer

discover the types of modifications present and characterising model systems to understand the processes leading to loss of vision. The structure of important eye lens proteins such as crystallin are being studied by nuclear magnetic resonance spectroscopy. The mechanism by which metabolites such as 3-hydroxy anthranilic acid, 3-hydroxykynurenine and agents such as ultraviolet light modify these proteins to form light-blocking pigments is being evaluated.

Virus pathobiology – Human cytomegalovirus

Human cytomegalovirus is a pathogen which is able to cross the placenta from mother to foetus and cause foetal abnormalities. This virus induces severe and often fatal disease in organ transplant recipients, as well as AIDS and cancer patients. It may have a role in cardiovascular disease because it has been implicated in lesion formation in cases of myocarditis and atherosclerosis.

Program members Professor Helen Garnett, Mrs Therèse Marengo, Dr Glenda Sullivan-Tailyour and Dr Salwa Woodroffe are investigating how human cytomegalovirus attaches to and enters into a number of human host cell types. These host cells include endothelial cells which line body cavities and blood vessels, fibroblast cells of the skin and lungs and monocytes, the white blood cells important in the body's defence against invading organisms. The possible outcomes of cytomegalovirus-cell encounters are (i) interaction at the cell surface only, (ii) entry followed by limited activity within the cells or (iii) entry followed by full replication with the production of numerous virus progeny, which can spread to infect neighbouring susceptible cells. Since all of these outcomes may potentially trigger changes which markedly affect the normal function of the cells, cellular functions following cytomegalovirus challenge are also being monitored.

Knowledge of the mode of entry of the virus into cells will contribute to the development of antiviral agents designed to block initial infection or spread of the virus through the body tissues. Virus effects in monocytes and endothelial cells will help to explain why patients with cytomegalovirus infection have a reduced ability to clear other pathogens or cancerous cells and elucidate the role of this virus in the development of atherosclerosis and myocarditis.

Program research has demonstrated that cytomegalovirus binding to fibroblasts is a two-step process, which involves an initial reversible interaction followed by a second, more stable attachment. Virus binding to the cell surface is the rate-limiting step in virus entry, as subsequent penetration occurs rapidly.

Virus pathobiology – Rabbit Myxoma virus, the causative agent of myxomatosis

Since its introduction to Australia, this virus has evolved into several strains. Less virulent strains now predominate, reducing the effectiveness of myxomatosis in controlling the rabbit population, which is a large drain on the agricultural productivity of Australia. Little is known about the pathobiology of myxoma, and advances in this area are required as a basis for developing future strategies for the biological control of rabbits. Ms Christine McComb is studying different strains of virus ranging from low to high virulence. The effect of the virus is examined *in vitro* by challenging cultured rabbit blood cells with each myxoma strain. It has been found that the virus affects the function of T-lymphocytes, an effect that would suppress the immune system of the rabbit. Further investigation into this immunosuppressive function has revealed a quantitative difference between strains of high and low virulence. Current work is attempting to elucidate the mechanism(s) involved in this suppression of T-cell function.

Vaccine development

The development of vaccines against diseases of humans and animals is be-

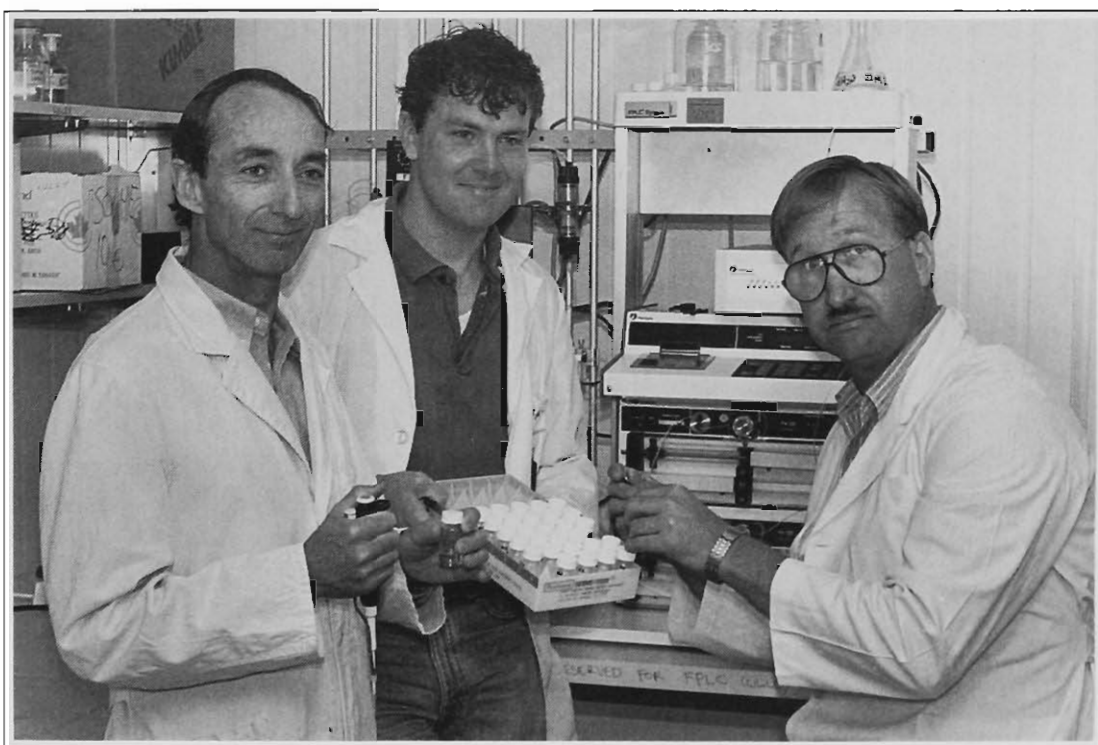
ing pursued by new program member Dr Mark Walker. His research is focused on the following three areas:

- (1) Development of carrier systems to present recombinant vaccines to the immune system. This work, which has been conducted in collaboration with the German Centre for Biotechnology and the University of Genoa, has demonstrated first, the utility of oral liposomes as carriers of vaccine antigens to stimulate mucosal immunity at the lung surface in mice. Secondly, oral immunisation with recombinant, live, avirulent *Salmonella spp.* has also been shown to stimulate an immune response in the lung.
- (2) Systems are being developed which will allow for the expression of recombinant detoxified pertussis toxin. This toxoid is the most effective vaccine component against the causative agent of whooping cough, *Bordetella pertussis*. The five genes which encode pertussis toxin have been cloned in a manner suitable for expression purposes. These genes will now be used in an attempt to overexpress pertussis toxoid to enhance purification of the recombinant antigen, and in the avirulent *Salmonella spp.* system in an attempt to develop an oral whooping cough vaccine.
- (3) In collaboration with NSW Department of Agriculture Elizabeth Macarthur Agricultural Institute (EMAI), vaccine antigen genes of several porcine pathogens have been cloned and expressed in avirulent *Salmonella spp.* These recombinant antigen delivery systems will be tested in mice, and ultimately in pigs, to determine their efficacy.

Cancer – The spread of malignant cells to other tissues

The mechanisms of cell migration during inflammation and cancer invasion are being investigated by new program member Dr Mark Baker. Monoclonal antibodies against proteins on the surface of cancer cells are in use. Mechanical

Associate Professor Ross Lilley, Dr Mark Walker and Dr Mark Baker undertaking gene sequencing operations in the Recombinant DNA facility



damage to tissues during inflammation and the role of free radicals is also being studied.

Proteinase inhibitors

The structure of Australian native Cucurbitaceae proteinase inhibitors is being investigated by Dr John Carver using nuclear magnetic resonance spectroscopy and computer-aided molecular modelling. These molecules have potential pharmaceutical roles in the treatment of rheumatoid arthritis, emphysema and cystic fibrosis.

Macromolecules: organisms and the environment

Carbon fixation by plants

The enzyme responsible for the fixation of carbon dioxide from the air by plants (rubisco) is a major determinant of the rate of photosynthesis and consequently of plant growth. The efficiency of rubisco is remarkably low for an enzyme; it has a low rate of catalysis of carbon fixation and promotes unproductive side-reactions. The development of an improved rubisco in plants by the techniques of genetic engineering is possible in principle. However, before the engineering of this complex protein can begin on a

rational basis, the catalytic mechanism must be understood. The expression of a catalytically improved rubisco would form the basis for obtaining dramatic improvements in the productivity and water use efficiency of crop plants.

Associate Professor Ross Lilley has developed a new technique for measuring the activity of this enzyme based on chemiluminescence. This assay procedure is of unprecedented sensitivity and provides a new window into the enzyme mechanism. In collaboration with the Research School of Biology at Australian National University, this and other techniques are being applied to elucidate the mechanism of this enzyme and of versions with genetically engineered modifications, with the long-term aim of developing strategies for improving its performance.

Genetic fingerprinting

The identification of separate strains and species by characterising differences in DNA sequence is of wide interest and applicability in biology. The development of new methods, based on the amplification of fragments of DNA generated by thermal cycling in the presence of random primers, is currently

proceeding at great pace. The green alga *Dunaliella* is cultured in Australia for the commercial production of β -carotene, a widely used food additive. There are many species and strains of this alga, but the classification is incomplete and the strains responsible for producing the highest amounts of β -carotene are not identified. Associate Professor Ross Lilley's research group is studying the application of these new techniques to characterising the different species of *Dunaliella* with special attention to those of significance for β -carotene production.

BULK MATERIALS HANDLING AND PROCESSING

Co-ordinator: Dr Arnold McLean (Department of Mechanical Engineering), tel. 21 3053

Members: Professor P Arnold, Dr P Cooper, Mr K Fish, Dr Z Gu, Mr O Kennedy, Mr R Pan, Dr P Wypych (all from Mechanical Engineering) and Professor N Standish (Materials Engineering).

SEVERAL members of the Program received major awards in 1992 for their continued research into the handling and processing of bulk materials. Notable of these was the receipt by Dr Peter Wypych of the inaugural A W Roberts award for his academic achievement and contribution to the technology of bulk solids handling. Particular contributions made in the past 12 months, by Peter and his research project team, include steady progress in the advancement and understanding of pneumatic conveying systems both lean and dense phase, stepped diameter pipeline technology, scale-up procedure, system configuration and material/system selection. This research effort was further highlighted and reinforced by the conduction of successful short courses on pneumatic conveying systems.

Investigations also continued into the development of scale-up procedures for low-velocity transport, which has been found for certain materials to produce complex and unexpected flow behaviour. An understanding of this behaviour is currently being developed by way of an experimental investigation using a variety of pipe lengths and diameters. This work and the development of a suitable general model, is now well advanced.

Considerable progress has also been made on the National Energy Research Development & Demonstration Program (NERDDP)-funded project (funds total in excess of \$350,356 over three years) to develop handling techniques for the injection of coal into boilers. This project which aims to investigate the accurate feeding, control and dense-phase transportation/ injection of pulverised coal and crushed Run of Mine (ROM) coal also attracted support from Pacific Power in the form of a donation of a full-scale injection test facility and the salaries for additional personnel. This facility is a major addition to the already extensively equipped Bulk Solids Laboratory. Test observations to date indicate that considerable improvements can be effected in regard the attainment of uniform flow, transfer and feed vessel design and operation and feed splitting. The results from this work will benefit the electricity generation industry by facilitating replacement of existing oil-fired main and auxiliary fuel systems by coal-fired systems. The technology developed will also benefit other industries seeking accurate and reliable coal-injection technology. These industries include iron blast furnace operations, medium-size boilers and non-ferrous smelting operations. In the longer term advanced coal-fired power generation systems will rely heavily on aspects of the technology under development.

Peter's award was presented during the successful conduction of the 4th International Conference on Bulk Materials Storage, Handling and Transportation and the 7th International Symposium on Freight Pipelines sponsored by the

National Committee on Bulk Materials Handling, The Institution of Engineers, Australia and co-sponsored by the International Freight Pipeline Society. This conference, which was attended by over 150 delegates, was subsequently complemented by the conduction of three two-day short courses. These courses utilised the expertise of several prominent overseas engineers/researchers present at the University.

The second award was the receipt of the degree of Doctor of Science by Professor Peter Arnold at the University's October, 1991 Graduation Ceremony. This award was made for his considerable contribution to the science of Bulk Solids Handling. This contribution is exemplified by the Program's research involvement in fundamental powder properties, bin wall loads, characterisation of powder packing, permeability, flow rate prediction and particle-size distributions. The success of this research is evidenced by the Program's significant involvement in industrial problem solving.

As regards fundamental powder properties research, notable achievements included the development of suitable test apparatus and procedures to measure powder de-aeration characteristics and powder Hausner ratio using an air shock wave compaction technique. Limited test results, observed to date, identify differences between seemingly similar materials. These differences explain, in part, the vastly different pneumatic conveying flow characteristics exhibited by various pulverised coal fuels (PF). This work conducted on the basis of an approved sub-contractor to the Australian Combustion Technology Centre (a Division of Australian Coal Industry Research Laboratories (ACIRL)) NERDDP/industry funded project is currently being correlated and confirmed by pilot-scale pneumatic conveying testwork. The overall results of the work will be used to declare recommendations to the coal industry as to the techniques to avoid flow difficulties associated with fine PF generated by grinding soft coals in mills set up to grind hard coals. Obviously the overall



Members of the Group with the auxiliary fuel-injection test rig donated by Pacific Power. Group members are, from left, Dave Cook, Trent She, Arnold McLean, Zhiong Gu, Peter Wypych, Scott Dunster, Oliver Kennedy and Renhu Pan (absent are Peter Arnold, Nick Standish and Paul Cooper)

thrust of this work is to enhance or at least maintain Australia's share of coal sales into the world pulverised coal injection (PCI) market.

The third program participant to gain an award was Mr K Fish, a final-year BE thesis student. As a result of his thesis work and presentations relating to it, Mr Fish was awarded the 1991 Department of Mechanical Engineering best thesis and runner up thesis presentation award and gained first place in the Society of Manufacturers, Sydney Chapter 1991 Student Project Pres-

entation Competition. These accolades reflect the importance of his examination of the techniques to reduce dust emissions during clinker handling at a local major cement manufacturing plant. This examination, conducted under the supervision of Drs Basu and Mclean from the Department of Mechanical Engineering, in collaboration with plant management, included recommendations for a number of plant improvements. A number of these improvements have been installed and monitoring indicates vastly superior performance relative to previous plant 'best practice'. As a result

of the continued significance of his work, Mr Fish has been granted approval, from his employer to conduct a ME Hons by research to expand specific aspects of his undergraduate work. These include the examination of fundamental theories relating to dust generation (especially in elevated temperature environs) and the development of a practical expert system for the long-term operation of dust-collection equipment. This study will also



Dr Arnold McLean and Trent She inspect some of the materials successfully transported in the low-velocity pneumatic conveying test apparatus

declare recommendations, based on Mr Fish's experience, for plant personnel training programs relating to dust-collection equipment operation and maintenance. In particular Mr Fish identified that plant personnel training and involvement, at all levels, are essential for long-term reliable and cost-effective pollution control.

A further outcome of this dust control research is the development of strategies to improve and design dust-extraction systems for general industry and also prepare and conduct short courses on the topic. This activity is in response to the demand expressed by numerous companies for this area of technology transfer. Aspects of the work also extend, under the coordination of Dr Paul Cooper of the Department of Mechanical Engineering, to the computerised design of duct work, prediction of system pressure drops, the identification of industrial dust sources and the interaction of dust with the human respiratory system.

A further significant award was the receipt by Dr A B Yu of a Queen Elizabeth II Fellowship to continue research into the prediction of the porosity, voidage and packing characteristics of binary and tertiary powder mixtures

including non-spherical particles. This work has far-reaching implications with regard to the performance and operation of blast furnaces, to the strength of pharmaceutical tablettes, strength and density of concrete blends and to the design and manufacture of fuel cells. This work, to be conducted at the University of NSW due to Dr Yu's recent lecturing appointment to the School of Materials Science, heralds increased collaborative research between the two Centres.

The research talents and strengths of the Research Program were also utilised to conduct a successful AIDAB sponsored 'Advanced Coal Preparation' course for four senior executives from the Indian Coal Industry. This two-month course, which included contributions from the Australian Coal Preparation Society and various coal industry personnel, was attended by a IPACE sponsored delegate from Indonesia.

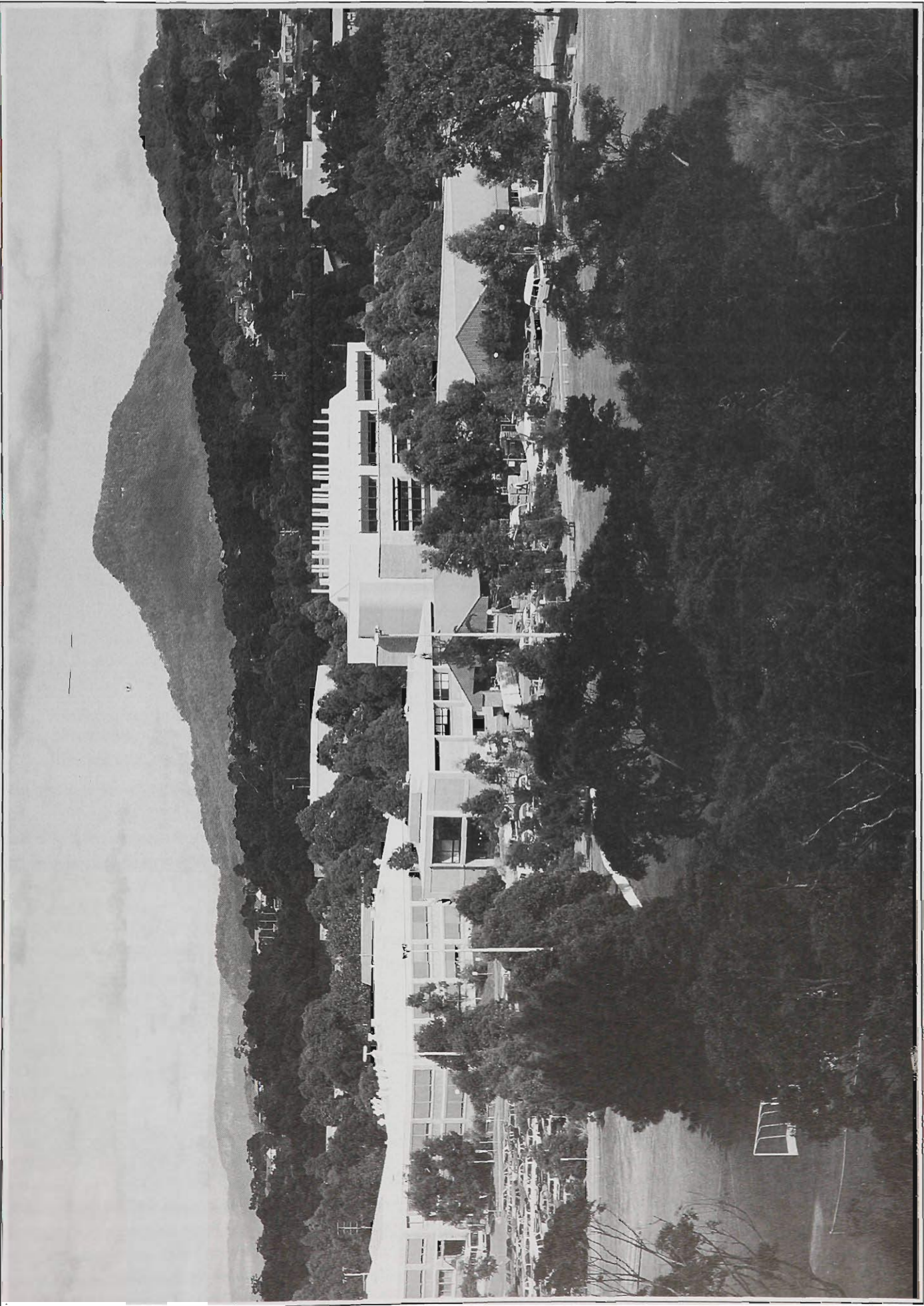
To ensure that the program continues to develop, several initiatives were introduced. These include research into techniques to minimise energy consumption and product degradation in pneumatic conveying. For this work funding is being sought from Australian Research Council (ARC) for hard-

ware and personnel. Tentative results of this research were presented at the recent International Conference on Wear in Holland.

An investigation also began into the application and performance of both skid and air supported belt in tube conveyors. This investigation, funded in part by a major South Australian conveyor equipment manufacturer, will eventually extend to the analysis of horizontal curved belt in tube conveyors. However, current investigations will be based on a pilot-scale test facility nearing completion in the Bulk Solids Handling Laboratory.

Another research development relates to the study of advanced coal utilisation techniques. Presently conducted by Mr D Liu at the Masters level, this work will be extended to the PhD investigation 'Integrated Gasification Combined Cycle (IGCC) Radiant Boiler Performance'. This project has already aroused interest from Pacific Power and received support from the CSIRO, Division of Coal and Energy Technology. Results of the work will have far reaching implications with regard to the development of more efficient less greenhouse gas polluting coal-fired power-generation systems.

As a whole the research program activities were highlighted by the publication or presentation of over 18 articles in key journals or national or international conferences. In addition income from the program's industrial problem-solving activities returned over \$150,000 to the Department of Mechanical Engineering and \$50,000 to the Faculty of Engineering for the Chair of Materials Handling and Processing, held by Professor Peter Arnold. In combination with funds from the University of Wollongong Research Program this income continues to provide the financial support to employ the equivalent of 1.5 Research Fellows, 1 Professional Officer, 2.5 Technical Officers and 1.6 Laboratory Assistants together with several casual research assistants. That level of support indicates extensive continuing University involvement in Bulk Solids and Physical Processing Research.

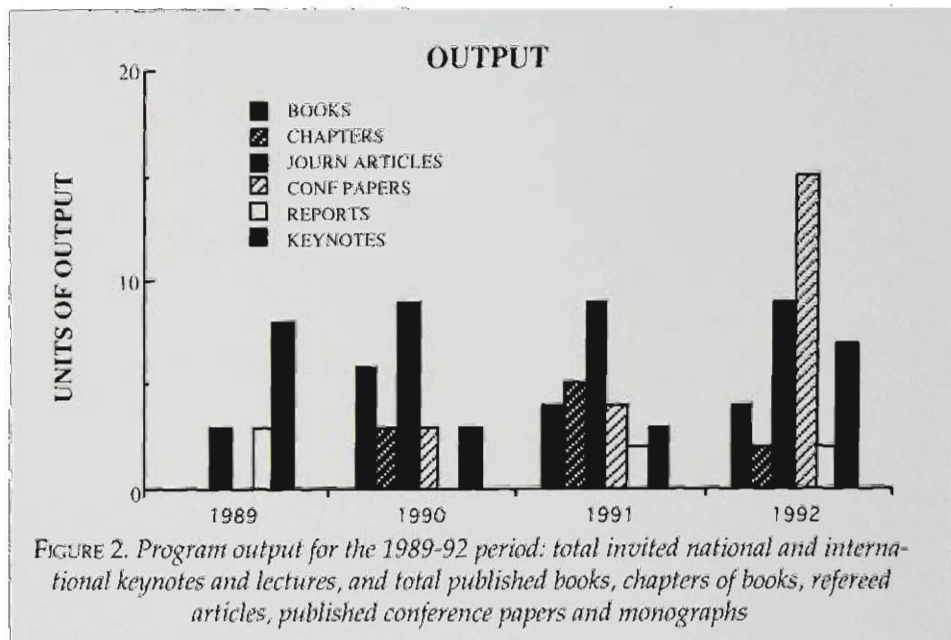


In its lush, park-like setting, the University's striking new Science Building (cost \$8.25 million) is readily distinguished by its multiple roof-top ventilating shafts

Members: Professor K Gannicott, Dr B Harper, Associate Professor M Harris, Associate Professor M Hedberg, Professor R Linke, Associate Professor J Patterson and Ms N Temmerman (all from Education).

IN 1992 the Education Policy Program entered its second triennium of operation, marked by further growth in every aspect of its activities. Intake in outside grants almost doubled over that of the previous year (figure 1) and publication output has also increased (figure 2). Concomitantly, the number of research students associated with the Program has been boosted with a substantial increase in enrolments, especially among PhD applicants (figure 1).

To facilitate research activities as well as integration of the students within groups of researchers, the Program has adopted a four-strand structure for its activities, each placed under the responsibility of a senior researcher, as follows



Strand A – Performance appraisal and program evaluation (Professor Russell Linke).

This strand relates essentially to the implementation aspect of education policy and planning, addressing such questions as how effectively the specified policy objectives are achieved and what other effects might occur as a consequence of implementation.

Strand B – Resource allocation (Professor Ken Gannicott).

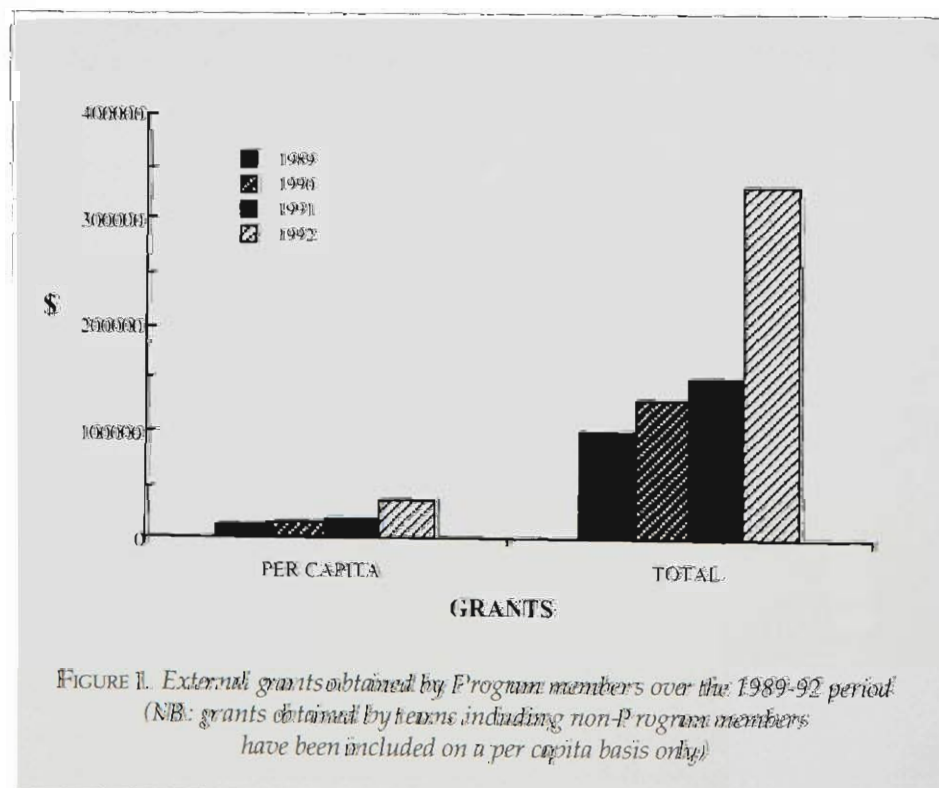
The resource allocation aspects of educational planning both in Australia and overseas are the focus of this strand, which covers education policy in South-east Asia and the South Pacific, as well as Australia.

Strand C – Policy formation and policy analysis (Professor Carla Fasano).

This strand seeks answers to the question – unanswered so far – of why countries' education systems that differ widely in their organisational design, financial, legislative and administrative frameworks, pedagogical philosophies and industrial relations, recurrently confront the same kind of crisis. This strand is set to seek answers through the study of policy processes *per se* – a largely uncharted territory in educational research – by means of theoretical and empirical methodologies.

Strand D – Performance technology in education and training (Associate Professor John Hedberg).

The effectiveness of the instruction, service delivery and administration in education and training is a central concern of this strand, which seeks to investigate ways of improving them with





Interactive multimedia workshop in session. Professor Carla Fasano, hand on chin, sits second from the right in the middle row

the use of integrated information technology.

National and International Activity

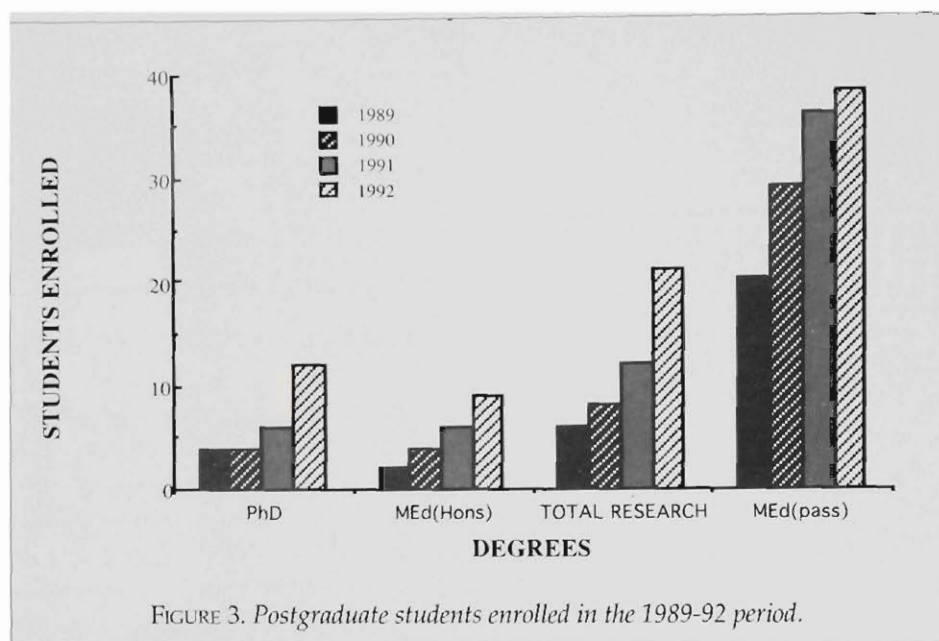
Within Strand A, Professor Russell Linke has continued his role as Australian representative with the Organisation for Economic Co-operation and Development (OECD)/International Management in Higher Education (IMHE) Project on Performance Indicators in Higher Education. Concurrently, he has been appointed to a Joint Ministerial Advisory Group on the University of New England Network. Professor Linke's contribution to the national debate on higher education has also continued. In 1991-92, he was invited to present papers on the application of performance indicators at a national workshop on Quality in Higher Educa-

tion held at the University of Melbourne. Additionally, an international journal, *Management in Higher Education*, invited him to write a paper on the Australian situation in relation to these issues. Professor Linke's current work has expanded to address the general issue of quality assurance in higher education and a paper on this topic, prepared for the Higher Education Summit conference in Sydney (June 1992), has been cited in the Higher Education Council's draft Report on Quality in Higher Education. This work will continue in 1993.

Within Strand B, Professor Ken Gannicott's activity has continued on a dual front. His concern with island countries in the South Pacific has seen him involved as a project director in a substantive study, *Pacific 2010*, undertaken at the National Centre for Devel-

opment Studies, Australian National University, and funded by Australian International Development Assistance Board (AIDAB). Involving a number of academics from other Australian universities, the project is designed to examine the economic and social consequences of high population growth, particularly in the fields of education and employment and to develop a range of policy responses. An initial report on this study, presented by Professor Gannicott at a conference earlier in the year, was the subject of the main feature article of the *Australian Financial Review* during March.

In a similar vein, Professor Gannicott's work expanded overseas with an invitation by the Asia-Pacific Development Centre (a United Nations organisation based in Kuala Lumpur) to undertake a survey examining the role of human



resource development in low economic growth areas of the South Pacific, drawing lessons from the more successful economies in South-east Asia. A report on the survey will be presented at a November conference. In addition to his South Pacific focus, Professor Gannicott has also researched Australian issues. His attempt to estimate the relationship between the present level of Higher Education Contribution Scheme (HECS) fees in Australian universities and excess demand for enrolment has already been accepted for publication. The paper calculates the level of fees likely to clear the shortage of places, on the assumption that the increased revenue from fees would be used to increase the number of places available.

Co-operative work with colleagues has been a preoccupation of Strand C, with Professor Carla Fasano initiating a major project, the Policy Space Project, involving five other researchers in the Program, across Strands. The Project, which adopts a multidisciplinary focus in studying current and possible new approaches to policy analysis and research, was finalised by Professor Fasano during her study leave at Stanford University; and with further plans to involve colleagues from that university as well as other universities overseas. As part of this Project, recip-

rocal advanced research training is achieved through structured weekly workshops, where each team member shares with the others knowledge on several specialised research techniques needed to conduct the project, and which she/he is acquiring/updating/polishing as the Project unfolds. Theoretical knowledge as well as concrete/practical outputs are expected in 1993 and beyond.

During her study leave at Stanford, the OECD and the University of Rome, Professor Fasano was also able to complete a study on education research policy in Australia for the Australian Association for Research in Education and collect data for her forthcoming project on the same topic, but instead with a focus on a number of OECD countries. Concurrently, Professor Fasano delivered three invitational addresses at international and national conferences/symposia, in the US and Italy, on education indicators and education research policy.

Co-operative projects were also actively pursued in 1992 by the Program's Strand D on Performance Technology. Under the leadership of Associate Professor John Hedberg and Dr Barry Harper, the Christopher Columbus Project (the Australian leg of an international R&D network of schools and

universities managed by Apple Computer) produced opportunities for several Program members to participate in research activities involving collaboration between the Faculty of Education, local schools and Apple Computer Australia. The design and production of innovative, interactive multimedia approaches to the enhancement of education quality and efficiency were the chief output of this activity. One of the concrete products, a package to assist the implementation of the new science education curriculum policy (*Investigating Lake Iluka*), was released during an Apple-funded national Technology High Schools Conference next December. This project will continue in 1993 with the development of the package to include further ecosystems and incorporating a presentation engine. Central to the development of the package has been the Australian Research Council (ARC)-funded research on cognitive demands on navigation systems undertaken by Associate Professor John Hedberg and Dr Barry Harper. Their research has led to the design and incorporation of navigation techniques in the package, which reduce the cognitive load on users.

The national and international standing of the team's research and development work has been recognised fully by a number of US experts requesting the opportunity to spend time at this university working with the team, and the significant success of a two-week intensive interactive multimedia workshop run by Dr Barry Harper and Associate Professor John Hedberg in September-October, with a contribution from distinguished US visitors. The excess of enrolment requests from other universities and industries around Australia and New Zealand will be gradually cleared through re-runs of the workshop in 1993.

A team approach is also being used to develop a new Department of Employment, Education & Training (DEET)-funded Research and Development project on Teaching by Telematics and Open Learning, for which a Vice-Chancellor Challenge Grant has also been secured. Initially, the project involved

the development and evaluation of some simple systems as well as the trialing of a number of pedagogical styles through a teaching program. Subsequently, more sophisticated hardware and software are being developed with the objective of producing a generic link for use by other university faculties.

Co-operation, this time across faculties, is also the focus of a DEET-funded Project of National Significance, involving Associate Professors Malcolm Harris and John Hedberg, with colleagues from the Faculty of Arts (project-coordinator:

Professor James Hagan). The project aims at developing professional development programs for History teachers teaching Australian History.

In summary and conclusion, the Education Policy Program has successfully achieved its objectives for 1992 and looks forward to further growth in quality output in the next triennium. National and international standing has been strengthened together with the intake of external grants. Publication output has also increased. As current research students – enrolments are also on the increase – complete their degrees,

their contribution to the Program as autonomous researchers is expected to enlarge the Program's volume of business even further.

Nita Temmerman and Brian Ferry are expected to be among the first to graduate in 1993, with a PhD and a Master of Education (Honours) respectively. Others will follow closely, with an especially rich crop expected in the Performance Technology Strand. As this occurs, co-operation within the Program is likely to expand as well as co-operation with researchers in other faculties and universities.

Members: Dr J Chicharo, Dr A Elshafei, Dr X Fang, Associate Professor V Gosbell, Dr V Ilango, Dr F Naghdy, Dr G Naghdy, Dr P Ogunbona, Dr B Perera, Dr D Platt, Dr G Trott (all from Electrical & Computer Engineering), Dr P McKerrow, Dr A Zelinsky (Computer Science) and Dr F Siores (Mechanical Engineering).

THIS Program now consists of 18 academic staff members from three Departments (Computer Science, Mechanical Engineering, Electrical and Computer Engineering) and 23 thesis students enrolled in Honours Masters or Doctor of Philosophy degrees. There is also substantial support for the Program through project work of undergraduate honours thesis students (over 25 in 1992) and course work Master of Engineering Studies students (over 10 in 1992).

The Program concentrates on three major interdependent areas of industrial automation:

- (a) Industrial electric drives and actuators including power electronics and control, electrical machine design, power system stability.
- (b) Materials handling, including robotics (kinematics, dynamics and control), force control, mobile robot navigation, cognitive science and sensor fusion, machine vision.
- (c) Fast processing using parallel processors (transputers) and neural networks applied to the control of robotics, industrial drives and integrated manufacturing tasks.

The Program's publication record, its ability to attract grants from industry and competitive funding bodies, and recognition by peer groups all demonstrate the considerable research strengths of the program in the three areas discussed above.

All the Program's major externally funded projects have proceeded well during 1992. These include the programmable array manipulator (PAM) project, funded by a government-industry research grant of \$500,000, research leadership in a \$1.5 million contract between Pacific Power and the University, and a grant of \$150,000 from the State Energy Research and Development fund (SERDF).

The PAM project has demonstrated working manipulators using transputers, DSPs and fast machine vision, based on pioneering work which is now being published. This project has also led to three Master of Engineering (Honours) projects.

The Pacific Power contract is now in its second year. Results include the design and successful testing of several inverters (devices which control electric power), the completion of several commercial contracts in the industrial drives and controls area, the awarding of PhD 'top up' scholarships to enable students to work with the program, and the use of the drives testbed, located in a University laboratory, for research result verification.

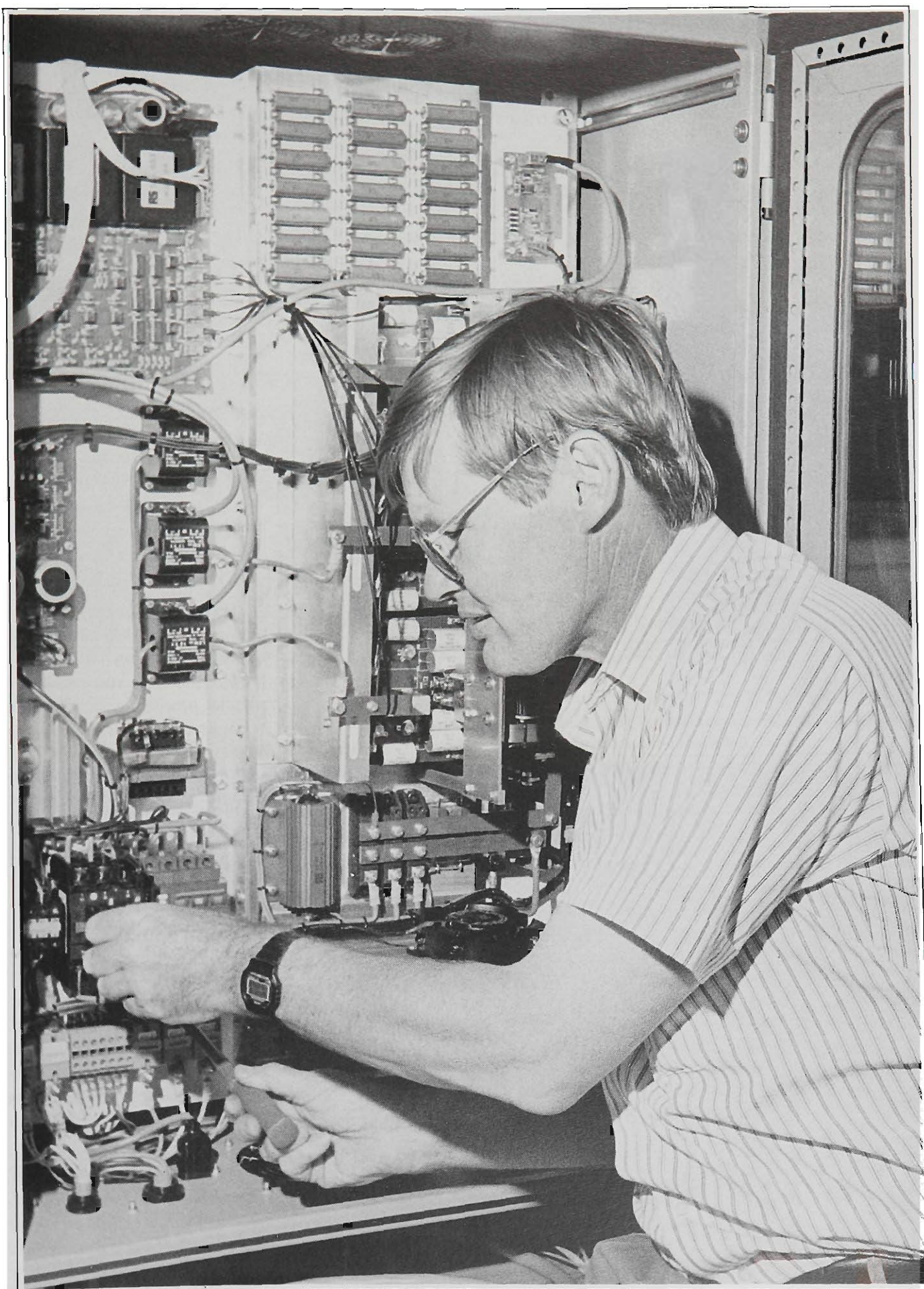
The SERDF project, now funding one full-time research associate, has shown

that improvements in operating efficiencies of electric drives can be achieved by innovative design of control circuitry.

Electric motors and drives are among the most important building blocks in industrial automation. It is often literally true that hardly anything in a factory moves unless an electric motor moves it. Consequently, this research supports work likely to lead to advances in this area. For example, one research project has resulted in the design of a new type of motor intended to produce a substantial performance improvement over conventional motors. The motor was manufactured as a result of the Pacific Power contract and tests so far performed on the test-bed have demonstrated that it can provide a four-fold increase in torque output as compared with conventional motors of the same size.

Another related area of current research interest is the control of 'pollution' caused by modern power electronic devices. These devices provide such good control over electric power that they are being used in increasing numbers throughout industry to control motors, and also to provide power to commonly used office equipment such as personal computers. The problem is that these devices inherently cause undesirable electrical side-effects (harmonics) which not only interfere with other people's equipment but also waste energy. One area of research in this Program has led to the development of new algorithms and fast computing to solve these problems.

Since electric drives and motors are central to most industrial automation systems, research in drives and motors will continue to develop in 1993. For example, this research now uses finite element techniques in the analysis and design of electric motors, and has incorporated advanced control and signal processing techniques in work on power system stabilisation and harmonic control. Innovative motors and inverters have also been designed, experimentally verified and reported on in



Associate Professor Vic Gosbell, with a harmonic generator designed to improve the quality of electric power systems

journals and at conferences. Several Honours Masters and PhD theses are in progress in this area. All these work areas will continue to be extended in 1993.

Tribute has also been paid to the strength of the researchers in this area (incorporating electric motors, drives and actuators) at the University of Wollongong by the appointment of the Industrial Automation Research Program co-ordinator to the Australian Electrical Supply Industry Research Board. This is Australia's prime research award-granting body in the Power Engineering area. Wollongong University has also been chosen to host the Australian Universities Power and Control Engineering Conference for 1993.

Another important and related area of industrial automation is materials handling. Research in robotics and other materials handling technologies is under way to provide better performance than is achievable with existing technology. This research has resulted in the development of new control strategies

to produce faster, more accurate robots, new manipulators including the programmable array manipulator, novel grippers, and the proving of new sensing, navigation, environment modelling and cognitive science techniques for enhancing mobile robots' performance.

At present, most commercially available automatic vehicles, used for example to move parts and materials within a factory, rely for their control on following wires buried in the floor. If a new path is required new wires have to be laid – an operation that is expensive, slow and inflexible. It would be highly desirable to build a mobile robot which could overcome these limitations by being able to navigate by relying on its own sensors. Such a robot would develop and update its own 'map' of the factory, and would be sufficiently intelligent to be able to devise its own path between any two points, and to steer safely around obstacles.

Research work in this Program is designed to provide mobile robots with these capabilities. Ultrasonic, vision and

other sensors are combined with novel algorithms, fast signal processing and computing to provide sufficient information to enable the robot to find its own way through its environment.

One of the Program's researchers, Dr A Zelinsky, was awarded external funding to spend time at one of the world's leading mobile robot research laboratories in Japan as the result of his research work in mobile robotics.

In 1993 work on the control and dynamics of fixed robots will be continued in order to verify experimentally the new mathematically proved adaptive control theory developed to date. New algorithms will also be developed to enhance gripper sensing capability, and faster processing techniques, strategies and architectures will be devised to allow the integration of control theory, signal processing, actuators, drives and sensors to improve the performance of robotic systems.

Most of the Program's research areas would benefit if faster processing techniques could be devised. Consequently the Program has successfully applied parallel processing techniques (using transputers) and neural networks to a number of problem areas. This work will continue to be developed in the future.

The Program has received a major boost to its equipment infrastructure as a result of the generosity of Illawarra Electricity, which will shortly make available SUN workstation equipment as a result of negotiations begun early in 1992 which have also involved the University of Wollongong Foundation, the Department of Electrical and Computer Engineering, and another research Program. The industrial automation focus of this program's work contributed significantly to the success of these negotiations.

The delivery of these workstations will greatly facilitate, in the long term, the Program's work, since currently available facilities cause severe bottlenecks because of the large number of research students and staff involved. These workstations will be a considerable asset since they provide fast simulation

Mr Jim Naumovski, a final-year honours thesis student, with the Robosoft Mobile Robot and associated equipment





Mr Philip Ciufo, ME (Hons) student with the Programmable Manipulator (PAM) Project showing vision and transputer equipment

platforms to all research areas, as well as finite element capability and transputer development facilities to all researchers.

This year's budget has, as previously, been invested in providing long-term equipment and staff infrastructure to provide support to all areas of the Program's research. Notable budget items for 1992 include the employment of a program engineer to facilitate the Program's often experimentally intensive research, the purchase of a high-performance SUN workstation to support all researchers and thesis students, the purchase of PCs and software to support specialised software packages, and the purchase of a digital Cathode Ray Oscilloscope (CRO) to allow precise high-frequency signal measurement and analysis benefiting several projects. Other expenditure continued to support existing infrastructure (eg VME system, Robosoft mobile robot).

The Program, through its co-ordinator, was asked by other Australian Research Institutions (CSIRO, RMIT, Swinburne) to provide research leadership in one of the three research strands prepared for the Manufacturing Co-operative Research Centre (CRC) application. The invitation for such close involvement in this CRC application indicates the high standing of the Program's work within the Australian Research community.

The Industrial Automation Research Program also has a number of international links including relationships in Japan (see above), Cambridge University, Sheffield University, Loughborough University (UK) and Technion University (Israel) in the areas of power engineering, flexible manufacturing and robotics. Industrial Automation Research program members spent (in total) 16 months at these institutions in 1992.

LABOUR MARKET ANALYSIS

Co-ordinator: Dr Chris Nyland (Department of Economics), tel. 21 4027

Members: Dr M Donaldson (Sociology), Dr C Harvie, Ms A Hodgkinson, Ms D Kelly, Professor D Lewis and Associate Professor R Markey (all from Economics).

UNEMPLOYMENT, the position of disadvantaged sectors in the labour market, and management/employee relations were among the topics researched by the members of the Program. The publication record of the Program has expanded, members have increased the output of joint research and there has been continuing success in attracting funding from external sources.

As a recognition of Australia's continuing unemployment difficulties, the Program hosted a conference, *'Responding to Unemployment'*, at the University in February. Anne Hodgkinson acted as organiser for the conference, the main aim of which was to present the latest research by members and invited economists, on the economic analyses of the labour market as it relates to unemployment. The discussions were stimulating and enlightening, demonstrating a wide variety of perspectives from which both unemployment and the labour market generally, can be viewed. A publication based on the conference papers is being prepared.

The Program has maintained its especial interest in the issue of disadvantaged sectors of the labour market. Charles Harvie, Stuart Svensen and Chris Nyland have undertaken a theoretical and empirical analysis of the impact of sex-specific labour laws. This research has sought to assess the value of such laws and to measure the extent to which this form of legislation induces sex segregation in the labour market. The study has concluded that a reform strategy based on the simple abolition of such laws would involve reductions in employee protection without necessarily producing any compensating increase in labour market opportunities for women.

Professor Don Lewis continued his research into sex segregation, with a study examining the physiological and psychological literature dealing with innate and acquired differences in cognitive and physical attributes, between the sexes, relevant for vocational purposes. Attributes in which there were significant sex differences have been identified, and linked with specific occupational categories. Results indicate that employment patterns are influenced by observed differences in attributes. Don Lewis and Brett Shorten have also continued to work jointly on Australian Longitudinal Survey Data.

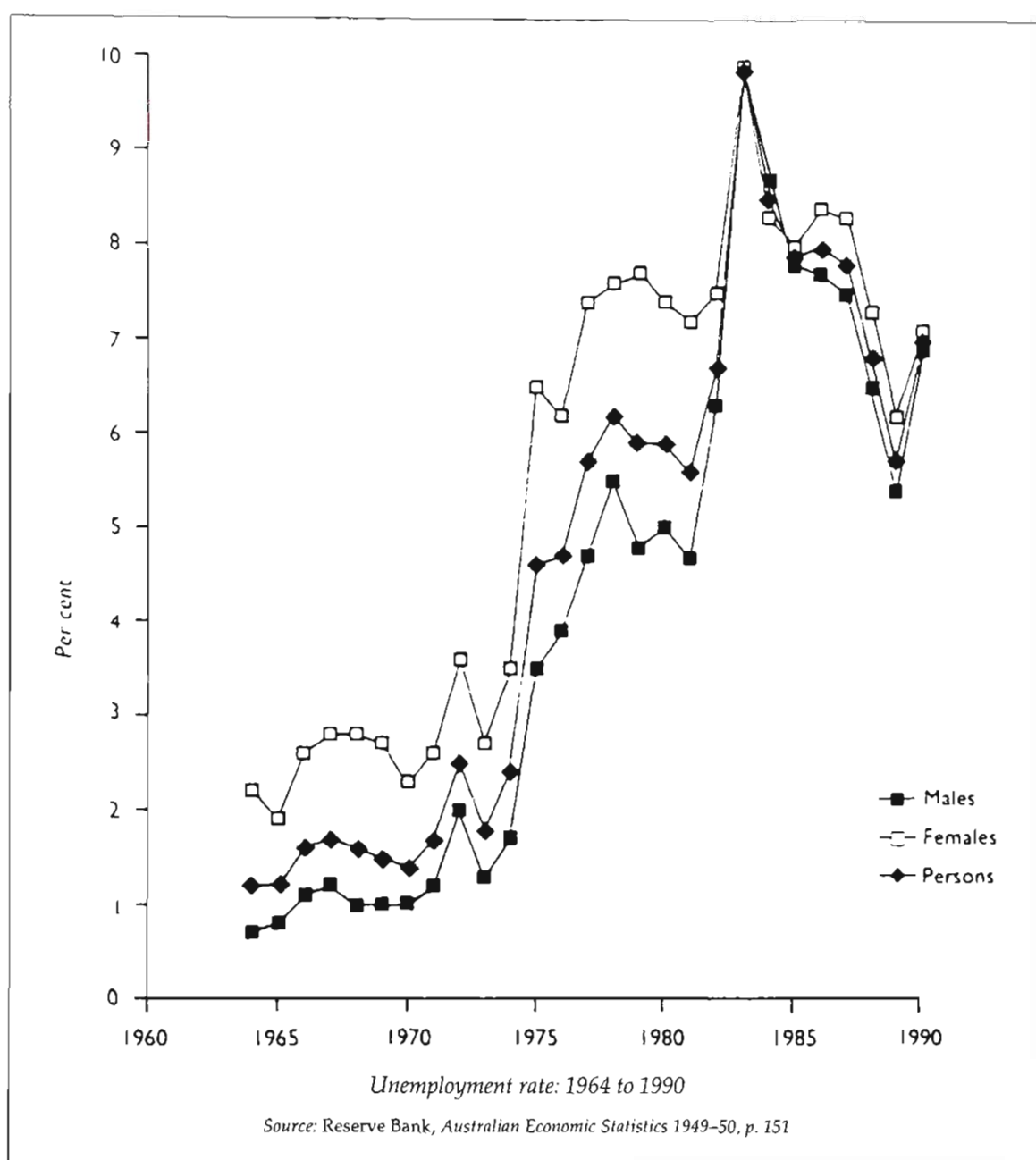
Chris Nyland has continued his studies into the history of how economic theorists have sought to explain the status of women, beginning with the works of John Locke, and continuing through to contemporary analyses. Dr Nyland is also engaged in a study of the nature of the scientific management movement and its place in the 'scientific and technological revolution' of the first half of the twentieth century.

Dr Mike Donaldson has been investigating a different facet of the same areas of sex segregation of the labour market, with his particular focus on trade unions. His book *Time of Our Lives: Labour and Love in the Working Class*, was published in 1991.

Dr Charles Harvie has extended his research on the employment aspects of the energy industry publishing a paper, 'Oil Production, Oil Prices and Macroeconomic Adjustment under Different Wage Assumptions', together with P Maleka, in the *International Journal of Energy Research*. Dr Harvie has also made a major contribution to the sex-specific protective labour legislation project already discussed.

In 1992 Di Kelly published a number of books, including *Researching Industrial Relations: Methods and Methodology* (Sydney) Australian Centre for Industrial Relations Research and Teaching (ACIRRT), together with Dr Tom Keenoy of the Cardiff Business School with whom she has worked previously. Ms Kelly is presently studying the effects of the introduction of new forms of management on industrial relations in the Australian public sector at all levels of government, with a longer-term view to expanding the study to a comparative analysis with parallel organisations in Britain. She has been invited to join the Massachusetts Institute of Technology project on International Transformation of Industrial Relations, with primary responsibility for publications in the Australian steel industry. She is also examining links between economic rationalism and industrial relations analysis.

Nadia Verrucci and Associate Professor Rob Castle presented a paper at the University in February examining problems affecting Aboriginal education, employment and training programs. Ms Verrucci also contributed a chapter to the book on industrial relations research methodology edited by Di Kelly. In addition, Nadia Verrucci has been invited to present lectures on wage determination in Australia, and women's unemployment.



Associate Professor Castle presented a paper, 'Economic Imperatives for Restructuring in Australia', to the ACIRRT Conference on Economic Restructuring in Australia and New Zealand at Sydney in May 1991. He also prepared a report to the government of Papua New Guinea on the evolution of the Australian Government's Industry Statement. His book, *The Evolution of Economic Ideas* (Melbourne: OUP) was published in 1991. Three volumes of the *Focus on Economics Series* (Melbourne: OUP) which he edited in conjunction with J Mangan, also appeared in 1991.

Ms Ann Hodgkinson conducted a ma-

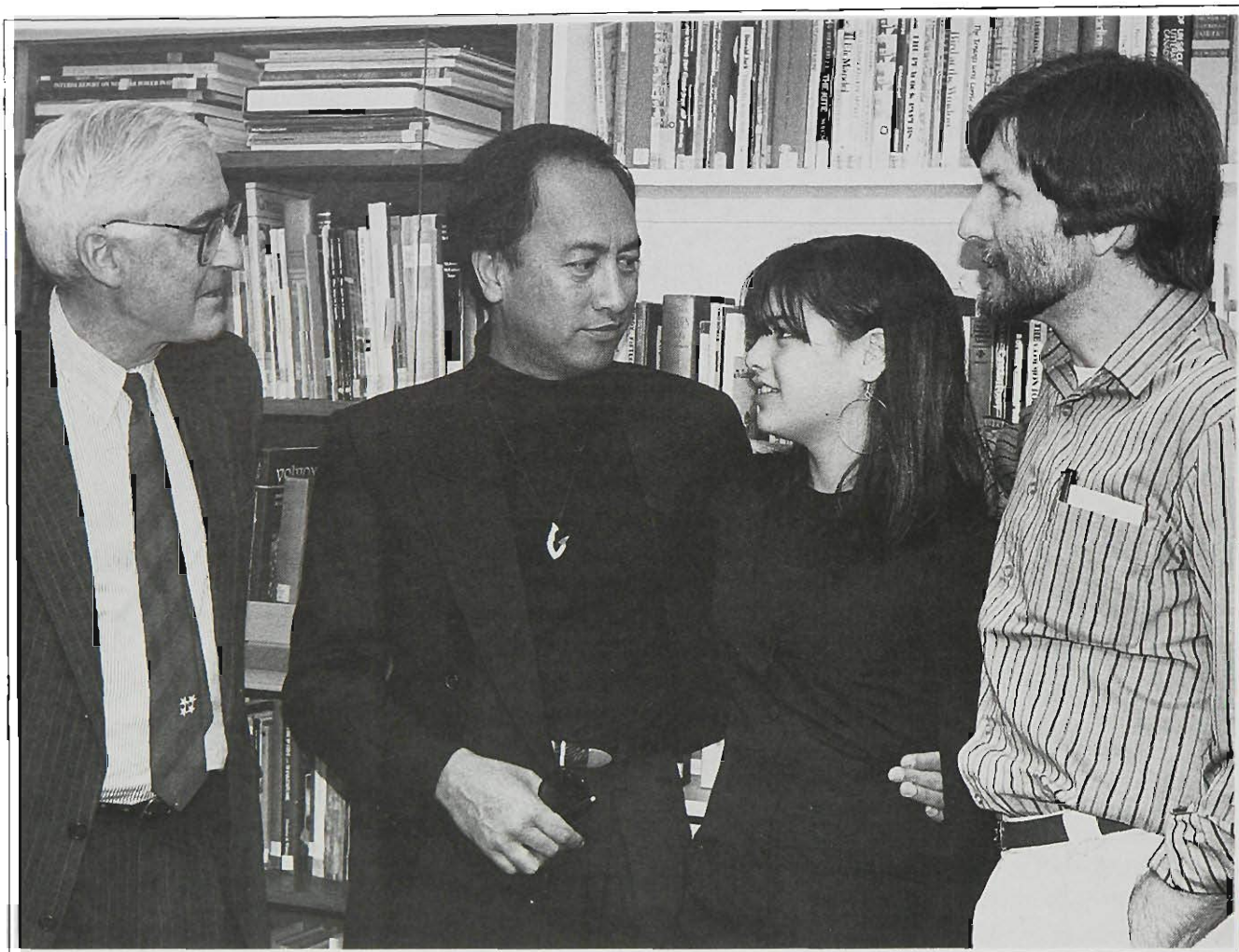
jor study of the relevance of neo-mercantilism to Australia. Statistical data on the Australian manufacturing sector were collected and analysed to test the hypothesis suggested by neo-mercantilist theory that import competition has caused a general decline in Australian manufacturing. No support was found for the hypothesis. It was concluded that if Australian manufacturing is to survive, attention needs to be focused both on domestic demand factors and to bilateral trade agreements. Ms Hodgkinson also began a study of possible employment effects on two major electricity producing regions if green-

house emissions were reduced to the 2005 Toronto target levels.

Throughout 1992, then, the Labour Market Analysis Group has benefited from steady membership and effective use of internal and external funding. Members of the Program have consolidated upon their research interests. The Programs increased effectiveness is apparent, first, through whole group activities such as the conference and the seminar program; secondly through joint activities such as those undertaken by members in small groups, and thirdly through increased individual research by most members.

LITERATURE AND THE COLONIAL LEGACY

Co-ordinator: Associate Professor James Wieland (Department of English), tel. 21 3677



New Zealand Consul General Mr Paul Cotton, Mr Witi Ihimaera, his daughter Olivia and Dr Paul Sharrad of the New Literatures Research Centre seen here during a visit by the noted New Zealand author to the University

Members: Dr A Cranny-Francis, Ms S Gillett, Associate Professor D Jones, Mr W McGaw, Dr K Newey, Dr L Ravelli, Mr M Scott, Dr P Sharrad, Dr G Turcotte (all from English), Dr G Rando (Modern Languages) and Mr M Stone (Education).

THE LITERATURE and the Colonial Legacy Program has been healthy from its inception. It has been partly responsible for the growth of the New Literatures Research Centre which now has a world-wide reputation and publishes two seminal journals in the field.

Over the past year, the program has further developed its teaching and research involvement in Canadian studies. Gerry Turcotte has taken up

editorship of *Australian Canadian Studies*, the journal of the Association of Canadian, Australian and New Zealand Studies (ACSANZ) and he has also received a grant from the Canadian government, to spend December and January in Canada researching his new postgraduate subject on the literatures of the indigenous peoples of Canada, Australia and New Zealand.

The program continues to generate a large publication output. (Publications are listed elsewhere in this report.) The two major bibliography projects – James Wieland's annotated bibliography of Australian literary criticism and Paul Sharrad's annotated bibliography of South East Asian writing in English since 1970 – are proceeding on target, with research assistant Richard Lever funded by the Program grant. The post-colonial issues journal, *New Literatures*

Review, edited by Paul Sharrad, is published twice yearly, and has a worldwide circulation.

This year has seen an escalation of the Program's 'Autobiography' project, in which all members are involved. Michael Stone's autobiography and Australia subject (ENGL395) has been moved from Summer Session into the mainstream, and Program members propose to develop an Honours or Postgraduate subject in the area. Paul Sharrad has scheduled a volume of *New Literatures Review* devoted to Autobiography. The project will host an 'in-house' conference on autobiography in 1993, and a National and International conference in 1994, both of which will generate published proceedings.

The Masters degree in Post-colonial Studies, born out of the program, has produced its first graduates and is at-

tracting increased interest in the field. The Program also has input into the Cultural Studies M.A. through subjects taught by Anne Cranny-Francis, Dorothy Jones and Paul Sharrad, and the Department of English proposes another Masters degree which will have electives covering Post-colonial areas.

Staff, postgraduates, honours students and visiting academics and writers meet regularly at the New Literatures Centre Seminar series. This year's visiting lecturers have included film-maker Susan Dermody, who spoke on her recent feature film, 'Breathing Under Water', Bernard Hickey, Professor of Australian Studies, University of Lecce, Italy, New Zealand Writer, Witi Ihimaera, Michael Hulze, English academic, Ms. Suvendi Pereira, Literary critic from Monash University, and Canadian academic, Joseph Pivato.

Three Program members presented papers on post-colonial issues at international conferences in the past six months: Dorothy Jones at the conference: 'Post-Colonization and Women's Texts' at the University of Calgary, Canada; Kate Newey at the conference of the German Association for the New Literatures in English, at the University of Bayreuth, Germany, and Michael

Stone at the International Society for Children's Literature conference in Paris.

The success of the Program's inaugural 'Feast on Film' festival in 1991 resulted in a second Festival, held from August 28-30 1992.

The Program organised Australia's leading academic drama conference, the conference of the Australian Drama Studies Association, in October. Katherine Newey, Maurie Scott and John Senczuk co-ordinated the conference, entitled 'Local Knowledges', to foreground the work of regional theatre in Australia. Writers Katherine Thomson and Wendy Richardson and director Des Davis discussed their work on plays based on life in Wollongong.

In response to very positive feedback from the 1991 conference, the Program will host a second Children's Literature conference, co-ordinated by Michael Stone. Entitled: 'Australian Children's Literature: Finding a Voice', the conference will explore the cultural influences – from Colonial to Post-colonial – which have contributed to the making of an 'Australian' children's literature. Michael Stone has been commissioned to write the Australian-New Zealand-Canadian section of the *Oxford History of Children's Literature* with an introduction on Post-colonialism and Children's Literature. The projected publication date is 1994.

Program members participated in the English Department's annual H.S.C. Study Day on September 26, which attracted more than 250 students.

The Literature and the Colonial Legacy program draws on a wide range of academic interests. It gains strength from the general harmony which exists in the English Department, and a willingness to promote the research interests of staff and students, both individually and co-operatively. There are currently 13 postgraduate students enrolled in English, working in the field of post-colonial literatures. The Program's vitality is to a large extent responsible for the Department's attractiveness as a centre for postgraduate study in this area.

QUATERNARY ENVIRONMENTAL CHANGE

Co-ordinator: Associate Professor Gerald Nanson (Department of Geography), tel. 21 3631

Members: Associate Professor E Bryant, Dr L Head, Ms A O'Neill, Mr D Price, Dr C Woodroffe (all from Geography) and Associate Professor B Jones (Geology).

THE Quaternary Period in which we live is the most recent period in the geological time scale and spans roughly the past two million years. In particular, the last 400,000 years has been a period of remarkable environmental change in the Australian region. With the use of thermoluminescence (TL) dates, radiocarbon dates, pollen and charcoal fragments, the middens of stick-nest rats, cores from coral atolls and satellite imagery, the Quaternary Research Program is piecing together evidence of important changes in our past environments, as well as monitoring present changes.

Fundamental to our understanding of the present, as well as our ability to predict future changes in the region, is a clear understanding of what the magnitude of past natural variations have been. If Australia is going to warm, rainfall increase and our sea level to rise as the possible result of 'Greenhouse', then there are natural analogues to these conditions in the recent Quaternary record. For example, the last interglacial (c125,000 years ago) is known to have had higher sea levels and is believed to have been considerably warmer than at present; the same is true of the early to mid Holocene (10,000-5,000 years ago).

Is our climate very close to a critical threshold which once exceeded will bring about a dramatic change in environmental conditions on the planet? Alternatively, does evidence from the past tell us that our system can tolerate considerable change, in for example temperature, before other environmental

variables such as precipitation and sea level will alter dramatically?

These geologically most recent times present the best possible scientific data for changed conditions on a warmer planet. Australia, however, is an enormously diverse continent and it is particularly important to understand the different effects of environmental change across our broad span of tropical, hot arid and cool temperate environments. Moreover, it needs to be clearly established which changes are attributable to human interference and which are natural. Research from the Program is rapidly piecing together a picture of natural environmental change and the occurrence of catastrophic process in Australia far more dramatic than has previously been contemplated.

Quaternary Projects

Central Australia

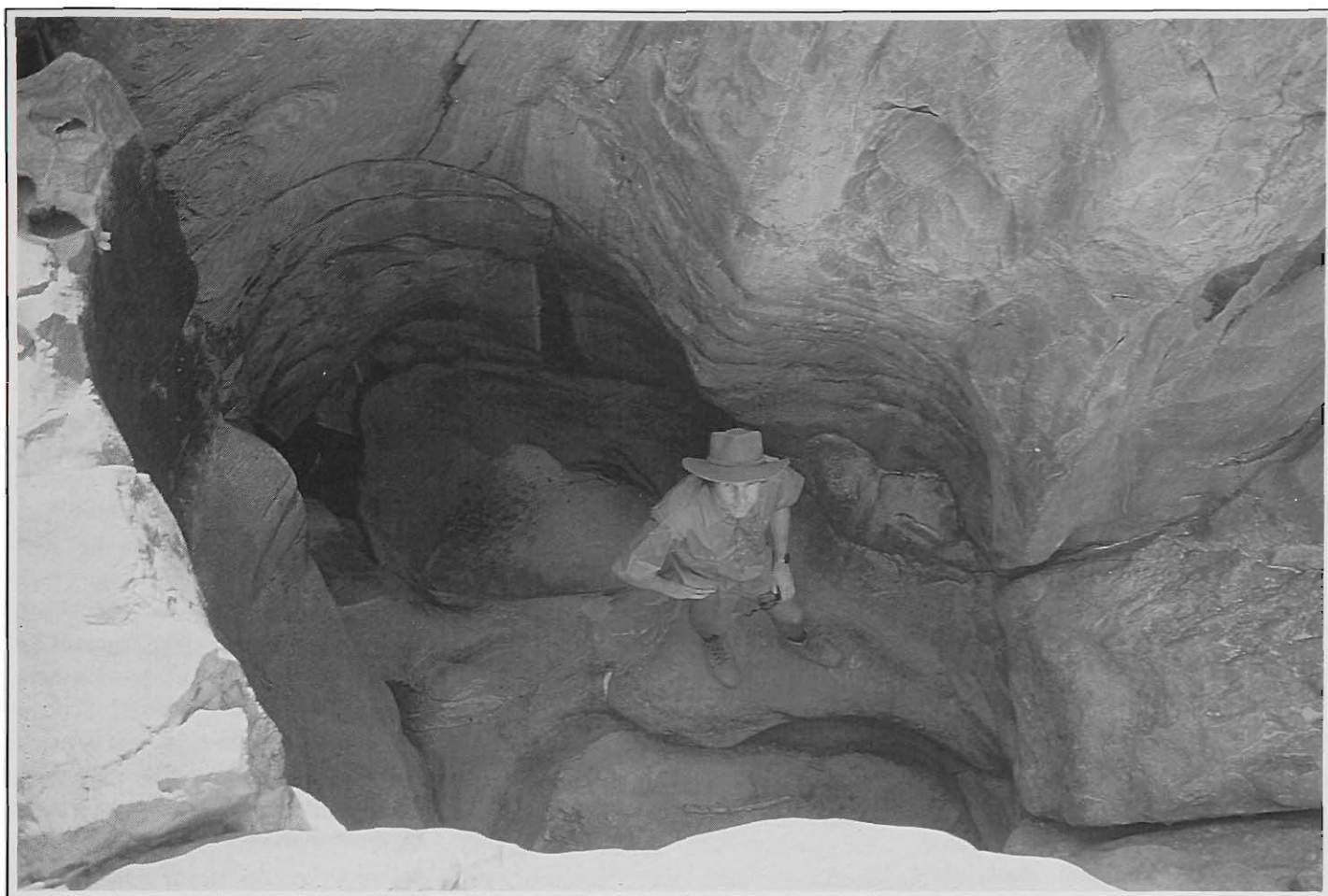
Over the past four years research from the Program has shown that huge river systems draining into the centre of the continent were largely inactive during the glacials when Australia's climate dried out, only to become highly active again during the late interglacials when extensive herds of giant mammals and reptiles migrated and lived along their length. Attention has now turned to the evolution of central Australia's vast dune fields and saline lake systems. TL dating has shown that during the last glacial maximum (about 22,000 years ago), Lake Eyre was more than twice its present size, filled with fresh water,



Left: Field crew at work drilling river deposits on the upper Mary River in the Northern Territory

Below: Bedrock river gorges in the Kakadu National Park in the Northern Territory sometimes exhibit these highly unusual 'fluted' surfaces. They result from very-high-velocity flow during large cyclone events, which cause cavitation (plucking) of the rock surface





Richard Walsh, a research student in the Quaternary Environmental Change Program, stands inside a vast pothole drilled into the face of a bedrock gorge during extreme flood events in the Kakadu National Park

fish and shellfish to a depth of 25m above its presently dry lake floor, and was forming beaches some 25km inland from the present shoreline.

Dating of the dunefields of central Australia has revealed a very old system of dunes being progressively reworked during each arid phase of climate. From the orientation of these dunes we have been able to determine changes in wind direction and shifts in the belt of high pressure that controls climate over the continent.

Stick-nest rats (*Leporillus spp*) have for thousands of years built nests of sticks and other plant remains in central Australia. These become cemented and preserved by viscous rat urine known as amberat, a material that also incorporates pollen as well as plant and animal remains collected by the rats. Radiocarbon dating and an analysis of the nest contents is allowing an interpretation

of changing vegetative and climatic environments over thousands of years in central Australia where other sources of pollen and organic remains are rare. Little is known of the pollen record from much of Australia and this study has the potential to provide environmental data from both the pre-historic and post-settlement timescales.

The monsoonal and humid tropics

Tropical estuarine research has centred on the Mary River in the Northern Territory, allowing the reconstruction of environmental change over the past 7,000 years. The dating of distinct palaeochannels on the estuarine plains has provided insights into the natural dynamics of the tidal creek environments. Rapid extension of the dendritic creek networks over the past 50 years has resulted in the destruction of extensive freshwater habitats on these floodplains; sea-level rise and the de-

structive effects of feral buffalo are possible explanations.

On a similarly contemporary note, the Program has started an investigation of the evidence for frequency and magnitude of megafloods caused by extreme cyclone events in northern Australia, work that, like the estuarine studies, could have important planning implications in the tropics.

In Sarawak (eastern Malaysia), a collaborative project with the Malaysian Geological Survey is examining Quaternary estuarine and river sedimentary sequences associated with the Baram River. Preliminary results suggest that TL dating may offer exciting new insights into Pleistocene environmental change in South-east Asia, and permit cross-correlation of changes in South-east Asia with the Quaternary changes reconstructed for northern Australia.

The Pacific Ocean

Of a controversial nature, very recent research into coastal deposits in New South Wales has found that there were high sea levels along this coast during the 'last glacial maximum' when they should have been 150m below present. This work has also shown that tsunamis (incorrectly called 'tidal waves') have destroyed most of the 'soft' coastal landforms south of Newcastle. Coastal barriers (sand hills) developed extensively along the New South Wales Central and South coast over the last three interglacials now only remain as eroded remnants; boulders have been rammed into rock crevices and huge blocks weighing many tonnes plucked out of rock surfaces well above present sea level; and unsorted coastal debris has been forced well up river estuaries and embayments.

In a very recent development, the Program has initiated research on Lord Howe Island, a location that supports the southern-most extent of coral reef in the world. Having formed six to seven million years ago, Lord Howe has moved slowly northward on the Australian plate into warmer seas in which coral can grow. Its fringing reef repre-

sents an early stage in Charles Darwin's sequence of coral atoll development, the latter stages of which can be seen in atolls such as the Cocos (Keeling) Islands in the Indian Ocean. Comparisons between these two locations will reveal important information on the processes and rates of coral reef formation under conditions of changing sea level and sea temperature.

Contemporary Projects

Lake Illawarra

The major industrial complex at Port Kembla adds heavy metals mainly in the form of airborne particulate matter, such as copper, cadmium, lead and zinc, to urban pollution entering the adjacent coastal lagoons and estuaries. Research from the Program has found that concentrations of heavy metals in the upper part of the substrate of Lake Illawarra range up to 200 times background levels whereas those in associated saltmarsh plants are up to ten times background; both sources are mobile within the food chain. Sedimentation rates in Lake Illawarra have been studied using heavy metal and flyash profiles together with C14 and Cs137 isotope measurements. These indicate that sedimentation rates have increased

tenfold following the urbanisation and industrialisation of the catchment.

Remote sensing and geographic information systems

The Program has pioneered some of the basic techniques for integrating microBRIAN satellite images with Geographic Information Systems (GIS) during a study of fires in the Kimberley of northern Australia to examine the usefulness of multilevel imagery for fire monitoring. A model has been developed of changes in fire regime and vegetation that reflects changing access to lands by both Aboriginal and more recent pastoral interests in the East Kimberley. This work is seen as a particularly important area of technological development in the Program and was reported at the GIS and Environmental Rehabilitation Workshop in Darwin in September 1992. It is hoped that this developmental work will be extended into other projects within the Program in the next year or so.

Conclusions

Important evidence has identified major climate oscillations involving the wetting and drying of central and tropical Australia as well as the cata-



Augering of sediments in the paleochannels found on the freshwater wetlands of the Mary River in the Northern Territory is providing an insight into the chronology of the channel occupation and abandonment



Buffalo charging through the wet-season floodwaters on the extensive plains of Kakadu. It is the hooves of these animals that have most probably eroded the muddy alluvial surface, extending the tidal stream networks and causing salt-water intrusion and die-back of the fresh-water Melaleuca forests on the floodplains

strophic destruction of coastal landforms by tsunami activity in areas where nobody suspected such extreme processes occurred. Despite fears of Greenhouse warming and associated sea-level rise, coral atoll research by the Program suggests mid-oceanic sea-level stability with no evidence of impending disaster. Stick-nest rats are providing ecological evidence of environmental change hitherto uninvestigated. Observations have been made of other historical and contemporary environmental changes, including the rate of infilling of lake Illawarra, the relative contributions of Aboriginals and pastoralists to burning of rangeland, and the loss of freshwater floodplains to salt water incursion, pos-



Postgraduate student Scott Smithers uses a laser level to determine height variations across the top of a large micro-atoll, several metres across, before sampling it. Measurements of the morphology of those intertidal corals are enabling reconstruction of water-level changes over the past century from mid-ocean sites such as the Cocos (Keeling) Islands in the Indian Ocean

sibly as a result of disturbance by feral buffalo.

The Program's investigation of palaeoclimate and palaeo flow-regime changes has recently moved into the semi-arid monsoon tropics of northern Australia (the Kimberley of Western Australia and the rivers of the Northern Territory) and the wet tropics of our nearest neighbours in South-east Asia (Malaysia and Indonesia). Sea-level research has been extended into the Pacific Ocean islands for direct comparison with data obtained earlier from

the Indian Ocean. Evidence for tsunami activity is being sought on the Queensland, Victorian and South Australian coastlines, for these may represent a significant risk to coastal properties and their inhabitants. Furthermore, the Program is examining evidence for megafloods in the monsoon rivers of northern Australia, for these also pose a serious risk to human habitation in certain regions. Remote sensing research within the Program over the next two years will take advantage of collaborative opportunities made available through the operations of NASA in Australia in 1993.

Toni O'Neill's sensing research at Lake Mungo in western NSW involves the use of a Global Positioning System to receive satellite signals from which to calculate precise locations of field sites



SCIENCE AND TECHNOLOGY ANALYSIS

Co-ordinators: Dr Brian Martin, tel. 21 3763, and Associate Professor John Schuster (both from the Department of Science & Technology Studies), tel. 21 3723

Members: Mr S Aungles, Dr R Badham, Dr J Brown, Professor J Falk, Associate Professor E Richards, Dr S Russell (all from Science & Technology Studies), Ms R Albury (Sociology), Dr R Joseph (Information Technology & Communications Unit) and Mr B Rogers (Education).

HOW SHOULD science and technology be evaluated, managed and controlled? Who should be involved in doing these things? These are complex and difficult questions. But their importance cannot be overstated in today's world where the need for answers is increasingly urgent. Modern science and technology underpin almost every feature of our society. They impinge daily upon our lives and shape our futures. Their economic and social significance is immense.

Science and technology are sources of knowledge and authority to which people increasingly look for guidance in political decision-making. In theory, they are strictly rational, impersonal and precise. In practice, they are deeply social undertakings, shaped by personalities, politics and cultural assumptions. For these reasons, science and technology are being studied in considerable depth and from many points of view at the University of Wollongong – from points of view including history, philosophy, sociology, anthropology, archaeology, political science and economics.

The picture of science and technology that is emerging is a fascinating one that challenges many commonsense and popular conceptions. This picture has profound implications for scientists and technologists, for policy makers and for the public.

The Science and Technology Analysis (STA) Research Program brings together researchers and postgraduate students who have the collective aim of promoting and integrating research into the nature, dynamics, impact and manage-

ment of science and technology in their social and cultural contexts. The largest number of STA members are from the Department of Science and Technology Studies; as well, there are a number of others from a range of other departments and faculties. Many members of STA maintain regular contact with the Centre for Research Policy, where several other researchers do related work.

Members of STA are involved in a range of projects and collaborations. There have been speakers from overseas hosted by STA; conversely, many members of STA have visited scholars elsewhere in Australia and overseas. STA working papers have been distributed to dozens of centres around the world. Some, but not all, of the activities of STA members over the past year are described below.

During 1991-92, Stan Aungles continued research into the changes taking place in higher education. At the departmental level he interviewed secretaries about the changing nature of their work arising out of first, the increasing use of information technology and second, the casualisation of their labour. At the university level he has been collecting information on information technology policy and the relationship of this to the actual usage of technologies. At the wider level, he has been assessing the possible effects on both staff and students when Australian educational institutions, with no previous experience/knowledge in the area, move into mass communication and mass/open education.

Dr Richard Badham is currently applying for \$780,000 from the federal Department of Industry, Technology and Commerce (DITAC) to fund Australian-German collaboration in research and development on a project on smart manufacturing techniques.

The project is industry-focused, with its core part the successful implementation of team-based production islands in a number of Australian companies. This will involve researchers and consultants being funded to assist the firms in the implementation process and develop

software and organisational methods suitable for production island operation in Australia.

The project is unique in a number of senses. First, it is an attempt to establish a technology transfer link between Germany and Australia that gives Australian researchers and consultants an active role in collaborative technology development. Secondly, it is based on the concept that the key component of successful technological innovation lies in effective organisational and human change, and is encouraging this view within the more traditional technology programs in DITAC. Thirdly, it combines industry practitioners and university researchers in an 'action orientated' project that has both a practical economic objective as well as a research objective.

As a practical economic project it aims to implement island-based production systems that dramatically improve productivity and increase worker skills, responsibility and satisfaction. As a research project it aims to develop new software and organisational techniques for production islands and to address the cultural dimension of production innovation. An important research outcome of the project will be increased knowledge and awareness of how far European responses to the 'Japanese Challenge' are relevant as an ideal and as a practical model for Australian manufacturing firms. Applications have been made to the Australian Research Council and to Brunel University's Centre for Research on Information and Communication Technology for funding to assist collaborative research on the broader culture and production issues.

The project has already received assistance from the Australian Research Council and the International Science and Technology Collaboration scheme.

Dr Sharon Beder has been researching the concepts, philosophies, attitudes and policies associated with the push for and discussion of sustainable development in Australia. This has involved an analysis of environmental economics and its socio-political dimensions; in

Jim Falk, Stan Aungles and Brian Martin discuss some of the common issues arising out of each of their recent books



particular, environmental valuation, national accounting, cost-benefit analysis and the use of economic instruments to achieve environmental goals. She presented her findings to the Ecopolitics VI Conference at RMIT in Melbourne and to the Department of History and Philosophy of Science at Melbourne University. The research was published as a book by the Earth Foundation Australia at the end of 1992.

Professor Jim Falk carried out research combining the analysis of technological change with the need to develop strategies for dealing with accompanying environmental problems. The central focus is on the urban setting where the bulk of environmental degradation, technological development and economic activity take place. The initial stages of this research strategy have involved building a research team and associated sources of data, now referred to as the Technological Change and Environmental Strategies (TCES) group, which is capable of intervening in real-world environmental problems. As well as Professor Falk, members of the group include Greg Hampton, Ann Hodgkinson, Kevin Parker and Stewart Russell.

In its first year TCES has attracted some

\$89,000 in grants and fees external to the STA program. It has completed a project for the US MacArthur Foundation (dealing with an urban strategy in relation to greenhouse emission reductions) and two well-received consultancies for the Commonwealth Department of the Arts, Sport, Environment and Territories (dealing with greenhouse emissions and the Australian coal industry, and social equity and the urban environment). It is currently assisting in the court case of the second Australian service veteran to sue the Commonwealth Government over his experiences at Maralinga.

Information and information technology have become central to economic activity. While information policy is recognised in other countries to be important, Australia has not developed a comprehensive approach. Dr Richard Joseph aims to trace the recent history of information policy in Australia to determine why the area has failed to achieve a broader acceptance in Australian policy circles. Apart from collecting information, Dr Joseph anticipates case study material being drawn from the former Western Australian Department of Computing and Information Technology, an early initiative by a state gov-

ernment in information policy. With knowledge of why policy development has failed, better approaches to information policy can be planned.

Dr Joseph's current research involves a project funded through the Telecom Fund for Social and Policy Research in Telecommunications, 'The politics of telecommunications reform: a comparative study of Australia and New Zealand.'

Governments provide massive funding of science and technology for war, but nothing at all for science and technology aimed at improving the effectiveness of non-violent struggle. Dr Brian Martin has been working to redress this imbalance. In collaboration with members of a local community group, he has interviewed specialists in telecommunications to find ways that the telephone system, computer networks and radio could be used to oppose a military invasion or coup. A key finding is that existing technologies could be used effectively for this purpose, but most people do not recognise their potential. But it is also possible to improve the usefulness of communication systems for non-violent struggle, for example by increasing the use of shortwave radio.

In December 1991, Dr Martin organised publication of an unusual paper in the research program's working paper series. The paper, by independent researcher Louis Pascal, argues that AIDS developed from contaminated polio vaccines used in central and west Africa in the late 1950s. Pascal's work was earlier refused publication in mainstream journals. Hundreds of copies of his paper have been distributed and have generated enormous interest internationally. Dr Martin is using the responses to Pascal's paper (and responses to similar work independently and subsequently published) to provide insight into the way the scientific community responds to challenging ideas.

Stewart Russell spent the first six months of 1992 in Scotland working on a book on institutional obstacles to the adoption of energy technologies, with the main case study being combined heat and power systems in Britain. He has collected material on recent developments, including privatisation of the electricity industry in Britain and its effects on generation technologies.

Sub-Program in History, Sociology and Politics of Science & Medicine (HSPSM)

This Program focuses on the central theoretical issues in the discipline of Science and Technology Studies, rather than applied, goal-oriented or directly policy related issues and aims. That is, it is the meeting point within the STA Program of projects dealing with basic issues in interpreting, explaining and modelling the nature and dynamics of scientific and medical knowledge, and technology systems. Like the field of STS itself, therefore, this sub-program is constituted in the domain of overlap amongst the following 'feeder' fields – history of science, social history of medicine, history of technology, philosophy of science and sociology of scientific knowledge. And, within that domain of overlap, it stresses (as current trends in STS in Europe and the UK also tend to stress) an historical, dynamic perspective on science, medicine and technology and their social relations, which is itself articulated to new and emerging models in the sociology of knowledge (and of artefacts).

Hence the overriding strategic aim of the HSPSM Sub-Program is to continue to foster high-level, internationally recognised research in the long established, sophisticated and highly competitive fields of history and sociology of science and medicine; and to contribute to the emergent disciplines of the so-called 'new' history and sociology of technology.

In 1992 HSPSM members continued their leading research projects in the history and sociology of science and medicine. However, it has been a year of primarily individual and consolidative efforts. Three new members joined the sub-Program – Dr Chris Nyland, Dr Steffanie Short and Dr Peter Thomas. Unfortunately for us, Dr Short left at mid-year to take up a senior lectureship at UNSW. Rebecca Albury and Associate Professor Evelleen Richards were on study leave, and the three sub-Program members who work in the Department of Science and Technology Studies were heavily involved in the Departmental Review.

Associate Professor Evelleen Richards has been further consolidating her international reputation in both the social history of evolutionary biology in 19th century Britain and in the socio-politics of medicine. She has been named to the Council of the Society for the Social Study of Science, the leading US organisation in the field of STS, and to the Editorial Board of *Isis*, the leading international journal in the history of science. This year she was accorded the unusual distinction of an Australian Research Council grant for the purpose of partially relieving her of teaching duties in order to continue her researches on construction of sexual selection in the post-Darwinian debates of the 19th century. This work will issue in a major book, under contract to the University of Chicago Press.

Associate Professor John Schuster's well-known research in the earlier period of the Scientific Revolution continued with publication of his paper entitled 'The Rhetorical Functions of Cartesian Method: Reclaiming Descartes for the History of Science', which started life as an invited, featured paper at the San Jose Conference Celebrating the 350th Anniversary of the Publication of

Descartes' *Discours de la methode*. It has appeared in a volume edited by Professor S Voss, and published by Oxford University Press containing contributions by other leading international scholars of Cartesian science. Associate Professor Schuster has also turned his attention to the pedagogical application of his researches in history and philosophy of European science, with the completion of a draft textbook, *The Scientific Revolution—New Introductory Lectures on the History, Philosophy and Politics of Science*. He was also invited by the New South Wales Board of Higher School Studies to join a team designing an HSC Distinction Course in History and Philosophy of Science, and in October he became Chairperson of the writing team. He has been re-elected as President of the Australasian Association for the History, Philosophy and Social Studies of Science for the fifth time in the past eight years.

One of the most pleasing achievements of the HSPSM Sub-Program has been the burst of field-work activity and resultant publication done by Mr Brian Rogers on the 'historical archaeology of Australian technology' – work crucially facilitated by the availability of Program funding over the past four years. He has further consolidated his emerging reputation with field work and comparative research on English, Scottish, Tasmanian and local Illawarra industrial archaeological sites.

In the critically important area where philosophy of science takes cognizance of recent developments in sociology of scientific knowledge, Jeffrey Brown continued his researches, as well as conducting STA Program internal seminars around these and related issues. Dr Chris Nyland has continued his ground-breaking historical work on the construction of gender and economic categories in the development of economic thought, adding a useful 'history of social science' aspect to the sub-program. Finally, Rebecca Albury and Peter Thomas have pursued their researches on the politics of medicine and health, focusing respectively on discourse politics and technological mediation of professional relationships.

Members: Dr R Arenicz, Dr Y Ashaari, Dr E Baafi, Dr M Boyd, Dr B Indraratna, Associate Professor D Montgomery, Dr V Nguyen, Dr I Porter, Professor R Singh, Dr M Sivakumar (all from Civil & Mining Engineering).

THE WATER Engineering and Geomechanics Research Program combines several related disciplines within Civil and Mining Engineering, with special emphasis on environmental issues, natural and man-made hazards, and resource development. Projects being investigated include flooding in urban catchments, sustainable water yield of catchments, water quality monitoring modelling and management, environmental hydraulics, re-use of waste materials, environmental noise impacts, landslides and slope stability, reinforced

earth, application of geomechanics to mining, geostatistical assessment of mineral resources, and environmental impacts of mining. The activities of the Program have grown rapidly, with nine members and one associate, plus nine external associates from universities, government agencies and industry. Thirty seven postgraduate students are associated with the Program. Major projects are described below.

Flooding in Urban Catchments

(Project Leader: Dr Michael Boyd;

External Associate: Dr Monica Bufill)

One project is concerned with identifying the factors affecting flooding in urban catchments, particularly the role of impervious pavements and antecedent soil moisture. A large body of data from 12 countries has been analysed to determine the most significant factors. Flood runoff has been shown to originate on two types of surfaces: impervious sur-

faces for both small and large storms, and pervious surfaces for large storms. Since the quantity and quality of runoff depends on the type of surface, this project will assist water quantity and quality management in urban catchments.

In a related project methods of flood control, which utilise temporary storage of floodwater in detention basins, are being studied. From this research three computer programs have been developed, marketed by Illawarra Technology Corporation and are being widely used in the engineering profession. They have been used for the design of several detention basins by Wollongong City Council, and in the recent upgrading of drainage works for the Illawarra Railway.

A collaborative research project with Commonwealth Scientific and Industrial Research Organisation (CSIRO) Division of Water Resources on determining pa-

In the Soil Mechanics Laboratory, at a demonstration of the computer-controlled Traxid Testing equipment, are Associate Professor Chowdhury, Dr Arenicz, Matt Houghton (fourth-year student), Ken Cunningham, Mr Xu (PhD student) and Dr Indraratna



rameters for flood estimation models has been successfully completed.

Water quality modelling and management

(Project Leader: Dr M Sivakumar)

Water quality management

Managing water quality in urban areas is becoming one of the most important issues in the water industry. Several projects are continuing on various aspects of water quality modelling and management in the urban environment. Analytical and numerical models are being developed for the prediction of water quality in urban catchments, in river and lake systems and within water distribution networks.

A project concerned with the destratification of Wollongong's water supply reservoir was successfully completed and three water-quality operations manuals dealing respectively with water treatment and distribution have been produced in collaboration with the Water Board.

Environmental hydraulics

Research is continuing on problems associated with sedimentation dynamics and oxygen transfer processes. These areas of research have particular importance in the deeper understanding of pollution-control processes.

River bank and bed erosion and associated sediment transport processes are of significant concern to practising engineers. This project is currently looking at various fundamental aspects of these processes.

Surface and underground mining

(Professor R Singh, Dr I Porter, Dr E Baafi and Dr B Indraratna)

Several projects are concerned with the analysis and design of support systems in underground mines, the modelling and management of mine water problems, geological modelling of ore deposits, and the application of geostatistics to investigation and development sampling for mines. In addition to computer work and laboratory

studies, field work with mining companies is being carried out. Computer-modelling techniques include using an 'Octree' algorithm to store geological data, and economic evaluation of an Indonesian Coal Deposit.

Slope stability and progressive failure – risk and reliability

(Project Leader: Associate Professor R Chowdhury)

After several productive years of work, very useful approaches have been developed to model the processes of progressive failure relevant to slope stability and landslides. The methodology for risk and reliability studies has been developed within a probabilistic framework and its use for real engineering studies has been demonstrated. There are significant possibilities for further developing these studies. The work has received recognition by the appointment of Dr Chowdhury to an expert panel of the United Nations Commission on Human Settlements. This work gives further impetus to the well-known 'observational approach' in applied soil mechanics. Moreover, it provides a rational framework for decision-making based on this universally accepted approach which has application to earth dams, management of major landslides, land reclamation and other geotechnical projects.

Geotechnical earthquake engineering

(Project Leader: Associate Professor R Chowdhury)

This is a new project concerned with the analysis of earth structures such as embankments and dams for earthquake loading. Following the Newcastle earthquake, there is increasing awareness of the need to design structures with due consideration of earthquake hazards. The research at Wollongong will lead to the development of a model for simulating the change in reliability of an earth structure during an earthquake. The current phase of deterministic studies will be followed by studies of the inertia forces and loss of shear

strength of the earth materials during an earthquake.

Work carried out so far has enabled a reassessment to be made of the failure of a major dam in the USA (Lower San Fernando Dam) which occurred due to an earthquake in 1971. The approach developed at Wollongong has several innovative aspects and should prove to be immensely useful in the understanding of major failures of earth structures during earthquakes. It could lead to the development of useful computational tools which geotechnical engineers can use in risk assessment of earth structures.

Reinforced earth

(Project Leader: Dr R Arenicz)

Research into the behaviour, design and engineering applications of reinforced earth is being pursued. This includes, apart from fundamental research in this area, the continuation of a joint research project with University of Brasilia (Dr Palmeira) on pull-out testing of strip reinforcement, and a project on the application of reinforced earth structures in a marine environment.

Utilisation of by-product, marginal or waste materials

(Associate Professor D Montgomery, Dr (Siva) M Sivakumar, Dr B Indraratna, Associate Professor R Chowdhury and Dr R Arenicz)

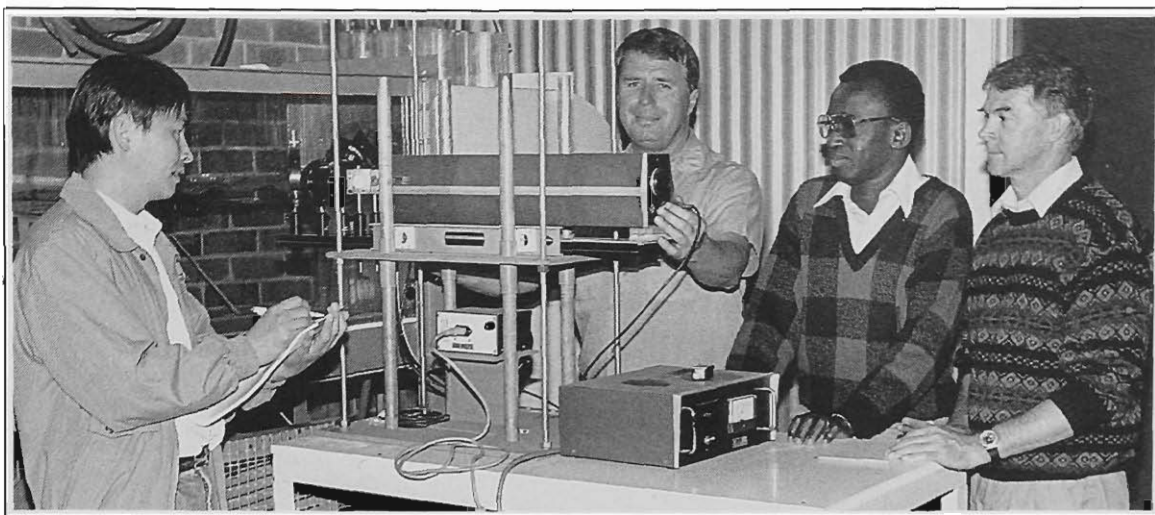
Several projects have been successfully developed and research continues on (a) the use of steel slag in road-base construction and its effect on pavement performance and (b) the use of sewage sludge and fly-ash for production of bricks – the 'BIOFLY' brick project.

(a) Biofly brick project

Project leader: Dr (Siva) M Sivakumar

Sewage sludge and fly ash are two waste products which can be successfully combined to produce the so called 'Biofly' bricks. This is an innovative project which produces lighter and stronger bricks and is believed to be a world 'first'. The concept has been successfully demonstrated in the laboratory.

In the Hydraulics Laboratory, inspecting the laser doppler equipment used for investigating suspended sediment concentration, are D W Xu (research student), Jim Britten, S.T.O., Dr Baafi and Dr Boyd



The second stage of producing actual size bricks has just begun, with both stages funded by Pacific Power, Water Board and Boral Resources. This project is attracting interest at national and international levels.

(b) Use of slag in engineering applications

(Project Leader: Associate Professor D Montgomery)

Investigations into the properties and uses of various types of ferrous slag in engineering applications have been in progress during the past four years. The major forms of slag investigated have been granulated blast furnace, ground granulated blast furnace, air cooled blast furnace and steel slag.

Engineering applications have included the use of these materials for soil stabilisation, road base, concrete aggregate and blended cement. Particular emphasis has been placed upon expansion-related properties of the slag and several new theoretical relationships and usability criteria, based on volume expansion and expansion stress, have been developed. Other areas investigated have concentrated on the early age strength development of slag-blended cement concretes and substantial increases in early strength, comparable to that of Portland cement, have been achieved through the use of chemical activation of the slag.

Through these various approaches, optimum use of the slag may be achieved. This will benefit industry and the community in general as a result of the economic savings in construction by the use of industrial by-product materials and the substantial benefits to the environment by less depletion of natural resources and reduced pollution due to discarding of industrial by-products. These benefits will be of immense economic and social value, with the additional attraction of being able to modify various engineering properties of construction materials.

Environmental noise assessment

With the appointment of Dr Y Ashaari the Research Program has expanded its activities into environmental noise assessment. Dr Ashaari's research interests are in geotechnical and environmental aspects of transportation. She is leading two projects in these areas.

International conference

The Program is organising a major international conference on Geowater and Engineering Aspects of Environmental Management, to be held at the University of Wollongong in February 1993. More than 220 abstracts were submitted from 30 countries, and 110 full papers have finally been selected for the conference. Members of the Program are offering short courses to be run in conjunction with the conference, and liaising with local engineering authorities to organise technical visits.

Publication of Book

Members of the Program were responsible for a new book *Geomechanics and Water Engineering in Environmental Management*, published by Balkema Press, 1992. Edited by Robin Chowdhury, and with four Chapters contributed by five members of the Program, the book has a total of 20 chapters (650 pages, hardcover) and with authors from 12 countries. This is a unique, interdisciplinary publication which is expected to be of interest to a wide range of professionals concerned with the management of the environment and especially with geo-water and engineering aspects.

International link program with Shenyang University, China

This collaborative exchange program was initiated by Dr M Sivakumar and Professor L Kane-Maguire in the area of Environmental Control Engineering after a visit to China. Six academic staff (three in Engineering and three in Chemistry) from Shenyang University have arrived here and are receiving training in various areas of environmental research. All three research fellows in engineering are supervised by Dr M Sivakumar. A group of four academics (Dr Sivakumar, Associate Professor Chowdhury, Professor Singh and Dr Boyd) will visit Shenyang in 1993 to give a short course in Environmental Control Engineering.

Members: Associate Professor M Bunder, Ms J Goard, Dr P Laird, Dr R Nilsen, Dr F Prokop, Dr G Williams (all from Mathematics) and Dr P Nickolas (Computer Science).

THE Analysis Research Group was established at the beginning of 1992. None of its members have been part of any other research program. Members are listed above. Associate members are: Professor Broadbridge, Ms Goard and Dr Nickolas. Research interests of the Group span logic, topology, functional analysis, topological groups and differential equations. These areas are of importance in their own right as well as for applications to other areas of mathematics and 'the real world'.

More than anything else, mathematicians need contact with other mathematicians. Therefore the main use of the funding provided by the Graduate Faculty to the Analysis Research Group has been to bring research visitors to the University of Wollongong. Visits have been for between one and four weeks. Distinguished visitors especially brought to Australia include Professors Ralph Kopperman and Peter Nyikos from the USA, and Dr Vladimir Pestov and Associate Professor Ivan Reilly from New Zealand. Other international visitors included Professors Igor Kluvanek, Shimeng Zheng and Michael Cwikel from Czechoslovakia, China and Israel, respectively. All the visitors have had significant research interaction with one or more members of the Analysis Research Group.

Specifically, Dr Pestov worked with Professor Morris and Dr Nickolas on free topological groups. Two joint papers have resulted. Each answers a significant open question dating back over ten years. In one it is shown that every open subgroup of a free abelian topological group is a free abelian topological group. The second shows that the free abelian topological group on a square can be embedded in the free abelian topological group on an interval. Professor Ralph Kopperman worked with Professor Morris, Associate Professor Bunder and Dr Nickolas on limit laws for varieties of topological groups. A joint paper entitled 'Limit Laws for Wide Varieties of Topological Groups' is nearly ready for submission. A further research note has been written.

Professor Kluvanek worked with Dr Nilsen on his major project in harmonic analysis. This work presents a new phenomenon in Fourier Analysis, the relationship between the behaviour of the Fourier transform near the identity, linear forms, and differentiation. Dr Nilsen has progressed significantly on his research monograph on this project. Now also involved in the project is Dr Williams. Further, the project has attracted a PhD Student, Mr Wai-Lok Lo, to work under the supervision of Dr Nilsen and Dr Williams.

Professor Morris and Dr Prokop presented papers at an international Topology Conference in New York and Professor Morris presented a paper at Seminar Sophus Lie in Germany. Professor Morris spent two weeks at the Darmstadt University of Technology working with Professor Karl Hofmann on locally compact groups and Lie groups. This resulted in two papers accepted for publication, one in the Mathematical Proceedings of the Cambridge Philosophical Society and the other in the Seminar Sophus Lie journal.

Professor Morris also presented a seminar on Sudden Cardiac Arrest to the Institute for Practical Mathematics in Darmstadt. Associate Professor Bunder attended the Australian Computer Science Conference, the Australian Mathematical Society meeting and the Australasian Association for Logic Conference, presenting papers at all three.

While in New York Professor Morris and Professor Gerry Itzkowitz did research on the Stone-Cech compactification of topological groups, with a paper being prepared for publication.

Over the past few years, Dr Graham Williams has written a series of joint papers with Professors W Ziemer and P Sternberg of Indiana University, on minimising the integral of the length of the gradient of a function. The minimum is sought in various classes of functions having given values on the boundary of a set. Such problems arise naturally in physical applications. A typical example is the problem of trying to find a bar of least weight which will support a given load. This problem does not usually have a solution but information can be found about near optimal solutions by looking at least



Group members: from left are Dr Graham Williams, Professor Phil Broadbridge, Ms Joanna Goard (standing), Professor Sid Morris (Dean), Dr Peter Nickolas, Dr Rod Nilsen, Associate Professor Martin Bunder and Dr Philip Laird

gradient problems. During the year Dr Williams and co-authors examined several aspects of this and have determined conditions when the optimal solution can be found. Dr Williams has also been working on the minimal surface equation, a non-linear partial differential equation satisfied by any surface having least area. He has been able to extend results to unbounded domains.

One of the most productive members of the group is Associate Professor

Martin Bunder, who has simplified and applied previous work on decidability problems in subintuitionistic implicational logics.

The Analysis Research Group had an extremely active seminar program during 1992 contributed to by all visitors and all members and associate members of the Group. The seminar program has attracted people from a number of other faculties as well as across the Faculty of Informatics.

Members: Dr S Avons, Ms V Bliokas, Dr E Chelakuk, Dr R Kruk, Dr J Wragg (all from Psychology) and Dr G Naghdy (Electrical & Computer Engineering).

THIS GROUP has as its focus the study of perception and cognition within an experimental framework. In addition it attempts to extend its basic research to a range of applied problems. The group's growing international reputation is reflected in a number of areas. First, one member each year since 1989 has been invited to at least one major international dyslexia conference as a guest speaker. Second, the group had a large number of international visitors to the University of Wollongong, especially in the last two years. Many came to Australia primarily to visit the group. Third, members have been asked to write an increasing number of book chapters or journal articles on their research.

A major area of progress in the last year has concerned the study of both verbal and visual short-term memory. Dr Avons and his group (Lee, Bibb,

Mulcahy and Harding) have been concerned with input and output processes in both types of memory. They have also been concerned with the relationship between visual imagery and visual short-term memory. They have extended this basic research by conducting a series of experiments on the effects of depression on memory. This has simultaneously increased understanding of memory in depressed subjects and enhanced basic knowledge of memory processing.

Professor Lovegrove and his students continued their investigations of spatio-temporal processing in normal vision. They (Amirkkhiabani and Pepper) have concentrated on the interaction between low-level visual mechanisms and higher-level cognitive factors. The group has worked on two specific applications. The first concerns visual processing in dyslexia. Lovegrove had shown previously that dyslexics have a basic deficit in that part of the visual system responsible for processing rapidly presented stimuli. That finding has been supported by recent anatomical studies conducted at Harvard Medical School. There has been some evidence to suggest that this timing problem in dyslexics may occur

in senses other than vision. Such a finding would help to integrate a large body of apparently disparate findings on vision and language processing in dyslexia. During the year (with Avons, C Wragg and Campbell) the group began to investigate this hypothesis in university students and dyslexics. Preliminary data are supportive. This exciting work will continue for some time.

A related project has investigated cognitive processes in pre-readers with the aim of being able to predict poor readers before they begin. This would allow earlier intervention. Wragg, Avons and Lovegrove tested a group of pre-readers in 1991 and followed them in to first class in 1992. This project will continue for some time.

Dr Wragg has been developing a cassette-based remedial program for extremely slow readers. The aim of this is to allow children to have one-to-one teaching which they need but rarely get. Preliminary results are encouraging.

Also investigated was a problem known as visual discomfort, which describes the effect that quite a large number of people experience when viewing printed text. A major difficulty work-



PhD student Karen Pepper interviews a young child as part of the Group's research on learning to read



Members of the Applied Cognitive Studies Group: from left they are Gholamali Amirakhiaban, Professor Robert Barry, Kristen Pammer, Dr Steve Avons, Professor William Lovegrove, Ms Elizabeth Conlon, Dr Jeff Wragg and Ms Karen Pepper

ing in this area has been the inability to identify visual discomfort sufferers accurately.

Liz Conlon (a PhD candidate) has completed a long-term study in which she developed a scale to measure visual discomfort and she has completed a number of validation studies. Together with Lovegrove and Barker, she is now looking at underlying mechanisms and possible treatments.

This year the group has been strengthened by the appointment of Dr E Chekaluk as a lecturer and Dr R Kruk from Ontario as a Postdoctoral Fellow. Dr Chekaluk's book on Eye Movements and Perceptual Processes has just been published. He will continue his studies

on eye movement and related processes. Dr Kruk, whose jointly edited book on Visual processes in Reading and Reading Disability is about to be published, will work on the remedial implications of a transient visual system deficit in dyslexics.

In addition, the group during the year had a significant increase in the number of honours and postgraduate students working directly with it.

Finally, a conference was organised for local teachers, guidance officers and parents. This attracted close to 200 participants. Two international visitors took part.

CONTEMPORARY ARTS PRACTICE AND PERFORMANCE IN AUSTRALIA

Co-ordinator: Dr Andrew Schultz (School of Creative Arts), tel. 21 3302



Dr Andrew Schultz, in a clearly pensive mood, as he works on the score for his new opera, 'Into the Shadows'

Members: Mr A Ford, Mr I McGrath, Ms S Rowley, Dr P Shepherd, Mr D Vance (all from Creative Arts) and Ms N Temmerman (Education)

THE year saw a marked increase in the activities and achievements of this group in both its collaborative and individual project work. Successful results included scholarly publications, journals edited, the publication of several books and the participation in – and mounting of – conferences with a substantial flow-on to creative work and enhanced postgraduate supervision. Specific current or completed projects include studies of

critical contexts for craft writing and practice,
the relationship between artistic practice in the visual arts and scholarly writing,
directions of contemporary tapestry weaving in Australia in relation to national and international movements,
interchange in Australian-Taiwanese visual art,
processes of lighting for the stage,

historical development of theatre technology in Australia,
trends in playwriting in Australia since 1960 with particular reference to influences on stage design,
constraints which impinge on the collaborative process in music-theatre production,
an annotated historical anthology of Australian music,
critical studies of music and post-modernism with regard to parody, meaning and text aesthetics,
music criticism in the Australian context, and
interviews with contemporary composers.

In examining the relationship between artistic practice, critical and theoretical writing about the arts and curatorial practice, Sue Rowley and Diana Conroy's work on developing theoretical frameworks for interpreting craft has continued to play a significant national role in generating insight into this area of cultural production. In 1992 their research has specifically addressed craft in exhibitions.

Since the previous report, the publishing house Allen and Unwin (in collaboration with ABC Enterprises) has commissioned from Andrew Ford a

book of interviews with composers. This will contain the fullest versions of interviews conducted as part of the research program to appear so far. In the past 12 months he has interviewed John Cage, Steve Reich, Tristan Kueris, Louis Andriessen, Kaija Saariaho, John Tavener, Judith Weir, Karlheinz Stockhausen, Alexander Goehr, Oliver Knussen and Poul Ruders. Towards the end of 1992 he was interviewing Brian Ferneyhough and Iannis Xenakis.

With Diana Conroy, David Chen and Deborah Hart, Peter Shepherd has begun to investigate the exchange of cultural material between Australia and Asia (particularly Taiwan). The project is to culminate in an exhibition of contemporary Australian Art travelling to the Museum of Fine Arts, Taipei, in late 1993 and a return exhibition of contemporary art from Taiwan coming to Australian galleries early in 1994. This is seen as a new approach to the sending of exhibition material from Australia to Asia, as it is a two-way congress, not merely a foisting of Australian material on another culture.

For Ian McGrath, the year saw the completion of a 300-page text, *An Approach to Stage Lighting* (a companion volume to his *A Process for Lighting the Stage*, Boston: Allyn and Bacon, 1990); intended for beginning stage lighting personnel, it has been accepted as a standard text by the principal tertiary theatre education institutions in Australia. A third text in the series is in its early developmental stage: 'Caretakers of the Vision: Directing the Technical Aspects of a Production' is designed to assist directors trained in handling dramaturgy the better to take on the technical responsibilities of a major production.

Group members actively took part in a number of conferences, locally and overseas. 'Distant Lives/Shared Voices' was the name of an international Tapestry Conference held in Lodz, Poland, at which Diana Conroy presented a paper, 'Tapestry and Archaeology', shortly to be published in Germany. A paper by Andrew Schultz considering

Associate Professor Peter Shepherd with Sue Rowley, who has taken up an appointment to the Projects and National Infrastructure Committee of the Visual Arts/Crafts Board of the Australia Council; she has also been elected Vice President of the Board of Crafts Council of NSW

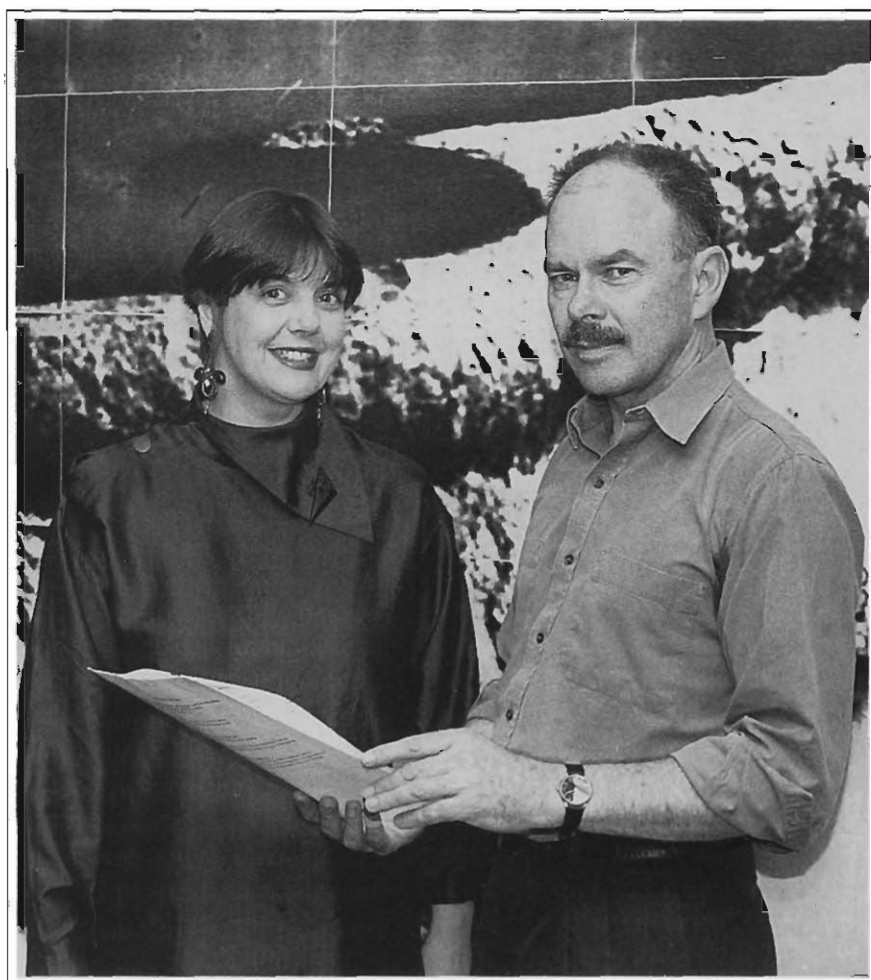
intertextual analogies for meaning in music and literature, 'There has to be a Reason, Composition as Text Analysis', was presented earlier this year at the New Music Australia Conference at Melbourne University and is soon to be published. Schultz is currently editing *Sounds Australian* No. 34 with the topic of Music Criticism. Ian McGrath delivered a paper 'Artisan or Craftsperson' at the NIDA, Theatre Training in Australia conference while at the University of Wollongong, Sue Rowley convened the first national conference on craft theory and curatorship (funded by a grant from the Visual Arts/Craft Board). She also spoke at the Craft 2000 Conference of the Crafts Council of Australia.

The past 12 months brought individual successes for various members of the Group. Andrew Ford – who contributes regularly to *ABC-FM* and *24 Hours* – was appointed Composer-in-Residence

to the Australian Chamber Orchestra. Andrew Schultz returned from an Australia Council, Composer Fellowship and a Fellowship from the Institute for Advanced Musical Studies, University

of London. In the area of consultancies and other professional involvements Sue Rowley took up an appointment to the Projects and National Infrastructure Committee of the Visual Arts/Craft Board of the Australia Council, and to the position of Vice-President of the Board of the Crafts Council of NSW; Diana Conroy was selected as NSW Committee member to choose and curate work for an exhibition of Australian Tapestry at the Jam Factory, Adelaide, in 1994; Ian McGrath is acting as Consultant and Course Co-ordinator for National Aboriginal and Islander Skills Development Association Technical Training courses; and, Andrew Schultz was appointed Chairman of the Board of Directors of the Australian Music Centre.

Diana Wood Conroy with a work which comes from her research into the archaeologies of different cultures. Her use of the grid system as an archaeologist is transposed to become an artistic device



Members: Dr D Arrigo, Professor P Broadbridge, Associate Professor D Clarke, Dr X Lu, Dr T Marchant, Dr A Worthy and Dr S Zhu (all from Mathematics).

THE Engineering and Industrial Mathematics Research Group aims at providing a high level of mathematical and computational expertise to areas of engineering and industry involving continuum mechanics (fluid and solid mechanics) and heat transfer.

The refinement of big industrial processes by trial and error can frequently involve considerable unnecessary expenditure, perhaps with the need to outlay millions of dollars on what is essentially untested design. For example, in the steel industry a continuous caster or a strip paint line process would involve a very large expenditure to set up and in both cases their ultimate successful operation would hinge on the operator's skill and experience. The Engineering and Industrial Mathematics Research Group is concerned with training at the honours, PhD and postdoctoral level to provide students and newly graduated researchers with the necessary mathematical, numerical and computational skills to model industrial processes with the object of providing a more solid scientific base to their operation and to identify the critical factors controlling the process and thereby reduce unnecessary expenditure and product wastage.

Mathematical modelling of industrial processes is not only inexpensive but in many cases may well be the only method of actually predicting numerical estimates of key factors which affect the process. For example, in the steel industry, accurate temperature measurements are often simply not possible because of the high temperatures which are involved. Thus the capacity for industrial mathematical modelling is not a luxury which industry can afford to manage without and the need to predict indus-

trial performance accurately is more likely to increase in the future.

Members of the Engineering and Industrial Mathematics Research Group have over the past three years been involved in mathematical modelling relating to the following diverse areas: Microwave Heating, Intelligent Materials, Cyclones, Wave interaction with solid offshore structures, Computer Aided Search for Symmetries, Elastohydrodynamic Lubrication, Deformation Characteristics of Bridge Bearings, Environmental Modelling, Flow of Granular Materials, Nonlinear Heat Transfer and Diffusion in Industrial Processes, Nonlinear Waves, Flow of Mould Powder in Continuous Casting, Bubbles and Cavitation, Vortex Sheets and Flow Separation, and a number of international publications have been prepared on each of these areas. The group is particularly renowned for its contributions to mathematical modelling of microwave heating, through the encouragement and guidance of Professor Howard Wornor. In this area alone the group has published 16 papers in international journals.

Professors Broadbridge and Hill continue to construct solutions to applied nonlinear boundary value problems involving nonlinear diffusion and on January 30 to February 1, the group organised a major international conference entitled 'Nonlinear boundary value problems in science and engineering', which attracted several international speakers, as well as over 60 delegates from throughout Australia. This meeting was very well received by all participants and has generated considerable prestige for the group and the University in general.

With colleagues from the University of Arizona, Professor Broadbridge has solved a nonlinear model for flow through unsaturated layered porous media which is the first available exact solution of its type. He has also derived some very accurate approximate analytic solutions for linear heat diffusion from a circular disk at constant temperature. This is a well-known practical problem that has applications to heat-

ing, ranging from a branding iron, pollution from a circular source and water flow from a disc permeameter used in the measurement of soil hydraulic properties. However, for several decades, the problem has defied many attempts at exact analysis. With two of last year's honours students he has also generated solutions for the practical problems of the absorption of water beneath a pond and the solidification of a liquid resting on a mould base with nonlinear thermal characteristics. In the first problem, the free boundary is the interface between saturated and unsaturated soil zones and in the second, the free boundary is the solidification boundary in a casting process where latent heat is released.

During the year Professor Broadbridge was elected to the editorial board of the highly prestigious journal, 'Mathematical and computer modelling', published by Pergamon Press.

Professors Broadbridge and Hill, ARC Research Fellow Dr Daniel Arrigo and PhD student Ms Maureen Edwards and Mr Tui Katoanga have been developing new methods of applying Lie symmetry group theory to construct exact solutions to nonlinear partial differential equations. This work received considerable impetus by the visit of Professor William Ames (Georgia Institute of Technology), Professor George Bluman (University of British Columbia) and Dr Peter Clarkson (University of Exeter) in February 1992 to attend the international meeting.

The recent research of Dr Marchant has centred on microwave heating and growing industrial use of this technology has been the motivation for the mathematical analysis of a number of interesting phenomena such as hot-spots. A hot-spot is an area of high temperature which can damage the product being heated (such as ceramics) and two papers on this topic have recently been submitted for publication. A new area of research interest is the hyperbolic theory of heat conduction. The classical parabolic theory suffers from the defect of an infinite wave speed which means

that heat is transported at infinite speed which is physically unreasonable. Hyperbolic models have finite wave speed and hence the occurrence of thermal waves. New exact thermal wave solutions have been derived for a model which has temperature dependent conductivity.

In the past year, Dr Zhu has quickly established an active group of post-graduates and one postdoctoral fellow, who are working on the numerical modelling of the ocean currents, temperature change and the storm surge induced by tropical cyclones. Other areas of research include numerical modelling of wave diffraction of short-crested waves around cylinders of arbitrary cross sections, nonlinear wave loadings of short-crested waves on circular cylinders, turbulence modelling, the dual reciprocity boundary element method and moving boundary problems in fluid flows. Wave loadings on offshore structures and the propagation of wave energy are of great concern to ocean engineers and environmental engineers. They are both directly related to diffraction and refraction of water waves in coastal regions. An analytical solution was first found for the linear diffraction and wave loads on a circular cylinder. Then, a numerical model was developed to calculate the wave diffraction field when short-crested waves are diffracted by a vertical cylinder of any cross intersection. A consistent way to improve the existing numerical scheme has been found with the numerical accuracy of predicting wave loadings on vertical cylinders being greatly enhanced. Nonlinear second-order wave forces due to short-crested incident waves on a circular cylinder were also examined. An analytical solution has been found, in terms of several singular double integrals.

In addition an inverse finite element method has been adopted by Dr Zhu to deal with free boundary problems in fluid flows such as Batchelor's flows. This project is still in its initial stage. The traditional finite element method is modified so that it can be used, with very fast iteration, to calculate the unknown free boundaries on which the



The Engineering and Industrial Mathematics Research Group. Back row from left are Dr D Arrigo, Professor P Broadbridge, Professor J M Hill and Dr S Zhu; in the front row are Dr A Worthy, Dr X Lu, Ms M Edwards and P Tritcher

unknown functions are nonmonotonic. A further new technique, which combines the block-up coefficients and the finite volume method, has been developed and applied to solve turbulent flows in a three-dimensional square enclosure with spacers. The primary numerical results are very encouraging and confirm the advantage of using such a combination in turbulence modelling. Finally the dual reciprocity method is a recently developed powerful technique for solving elliptical partial differential equations, which are frequently encountered in computational fluid dynamics and water wave modelling. An improvement to this technique has been found and the corresponding numerical experiments have been completed.

In addition to working with engineering and industry the group has fostered the development of Computer Aided Learning in Mathematics and Dr Worthy has received considerable funding for this project. Computer Aided Learning (CAL) Modules in the Foundations of Mathematics have been developed. The education goals of the CAL modules are twofold. The first of these is to affect the attitudes of participants who have negative feelings concerning Mathematics, especially fear, inadequacy and embarrassment so that these feelings will be reduced. The second is to

develop a level of mathematical skill so that students will become competent in handling problems in their first-year mainstream mathematics subject at Wollongong University. In particular, the modules are designed for those students whose background is deficient in the fundamental concepts of mathematics or those students who feel the need to improve their understanding of concepts and definitions in mathematics before entering the mainstream mathematics subject. Two major grants have been awarded for work in this area, \$87,000 from the Department of Education, Employment and Training (DEET) and \$10,000 for Apple University Development Fund (AUDF).

The Co-ordinator of the group, Professor Hill, has received the award of Companion of the Institute of Engineers (Australia). This is a very rare award, involving membership of the Institute equivalent to a Fellow but for people with non-engineering backgrounds. He has also been asked to serve on the National Committee for Theoretical and Applied Mechanics, a committee of the Australian Academy of Science. In this role he has put forward this University (together with Professors Arnold and Schmidt) to organise an International Union of Theoretical & Applied Mechanics (IUTAM) meeting on Granular Materials.

EXPERIMENTAL AND ANALYTICAL STRESSES OF STRUCTURES

Co-ordinator: Dr Richard Kohoutek (Department of Civil & Mining Engineering), tel. 21 3385

Members: Professor D Dunne (Materials Engineering), Professor S Morris (Informatics), Professor T Rozgonyi (Engineering) and Professor L Schmidt (Civil & Mining Engineering).

THE MISSION statement was carried out in the group's first year. Group activities span several departments and two faculties. The emphasis is on stress analysis in different conditions in the fields of Civil, Mechanical, and Materials Engineering. Special areas are brought in by members with mathematical background, and there is a senior practising consulting engineer on the application side of problems.

The group had several formal and numerous informal meetings in its first year. Formal meetings were held to discuss the aims, objectives and strategies of research plans, while informal meetings focused on developing the projects. Where no external funding was available, funds allocated from the University were assigned to new projects. The aim was of course to produce results which would attract future financial support.

Some projects are supported by the Australian Research Council (ARC) and others by industry.

Two projects supported in 1992 from University funding included

'Strength of Curved Monorail Beams' and 'Strength of Bottom Flanges', with four members participating. A curved beam was made for testing, using loads produced by a hydraulic jack, with measurements using strain gauges, load cells and photoelastic coating. The aim of the project is to establish guidelines for designers of such beams in Australia – information not at present available. Monorail beams are frequently used in bulk-materials handling.

'The Effect of Residual Stress on Fatigue Behaviour of Implanted Tool Steels' has two members investigating the fatigue characteristic of surfaces. The principal objective was to examine the fatigue characteristics of implanted surfaces. Central to this was the establishment of a rotating-bending fatigue-testing machine. A sum of \$14,000 was originally sought for the purchase of commercially available equipment, but because of reduced funding, only \$3,000 was made available. The equipment was therefore built in-house. It was designed and built in the Department of Materials Engineering and is now commissioned and tested. However, the delay resulted in a reduced rate of progress; it is therefore expected that the project cannot now proceed according to plan.

'Cyclic Loading of Reinforced Concrete and Composite Columns' has two members investigating cyclic movements produced by earthquake or machinery. The application of this project is in improved resistance of buildings both to earthquakes and machine-produced vibrations.

'Stress Analysis of Tubular Sections and Semi-Rigid Joints' is a project involving three group researchers, investigating joint behaviour, strength and fatigue life of structural members, and two projects concentrating on joint behaviour and inelastic behaviour of concrete-filled tubular members respectively. Investigation is to determine the ultimate load behaviour of pin-ended stocky steel tubular columns filled with concrete. A detailed strain gage investigation of the stress distribution in the steel tubes, under increasing load, has been carried out in a series of composite struts. Computer analyses have been, and continue to be, carried out in order to model the behaviour. The application of improved understanding is in increased load-carrying capacity of curved members used for sports stadiums, industrial buildings, offshore platforms, town and city developments.

'Dynamic and Static Stress Analyses of Railway Track' has three participants from the group, investigating stress levels in all components. Several rails have so far been tested, using strain gauges and the photoelasticity method.

Other projects which are fully supported by external funding or use the equipment from other projects include:

- Investigation of methods for inspection and monitoring of road bridges, in conjunction with Road and Traffic Authority (RTA), Australian Postgraduate Research Award Industry (APRAI). Extensive investigation was requested by the Road Traffic Authority, NSW, of a bridge in Dubbo, for static and dynamic loads effect. The group was also involved in planning the tests. The accuracy of predicted and measured results is excellent, making calculations for new designs and possible modifications to the existing structures a viable proposition. New bridges on the Mittagong bypass were also investigated before their opening to public. The report on Mittagong is in preparation. RTA also requested advice and measurements for two bridges in Sydney, and testing is in progress on a timber bridge in Picton.



The domed structure under Group inspection: from left are Dr R Kohoutec (Co-ordinator), Professor S Morris, Miss L Middleton, Professor L Schmidt, Dr A G McLean, Professor T Rozgonyi and Mr G Dehdashti

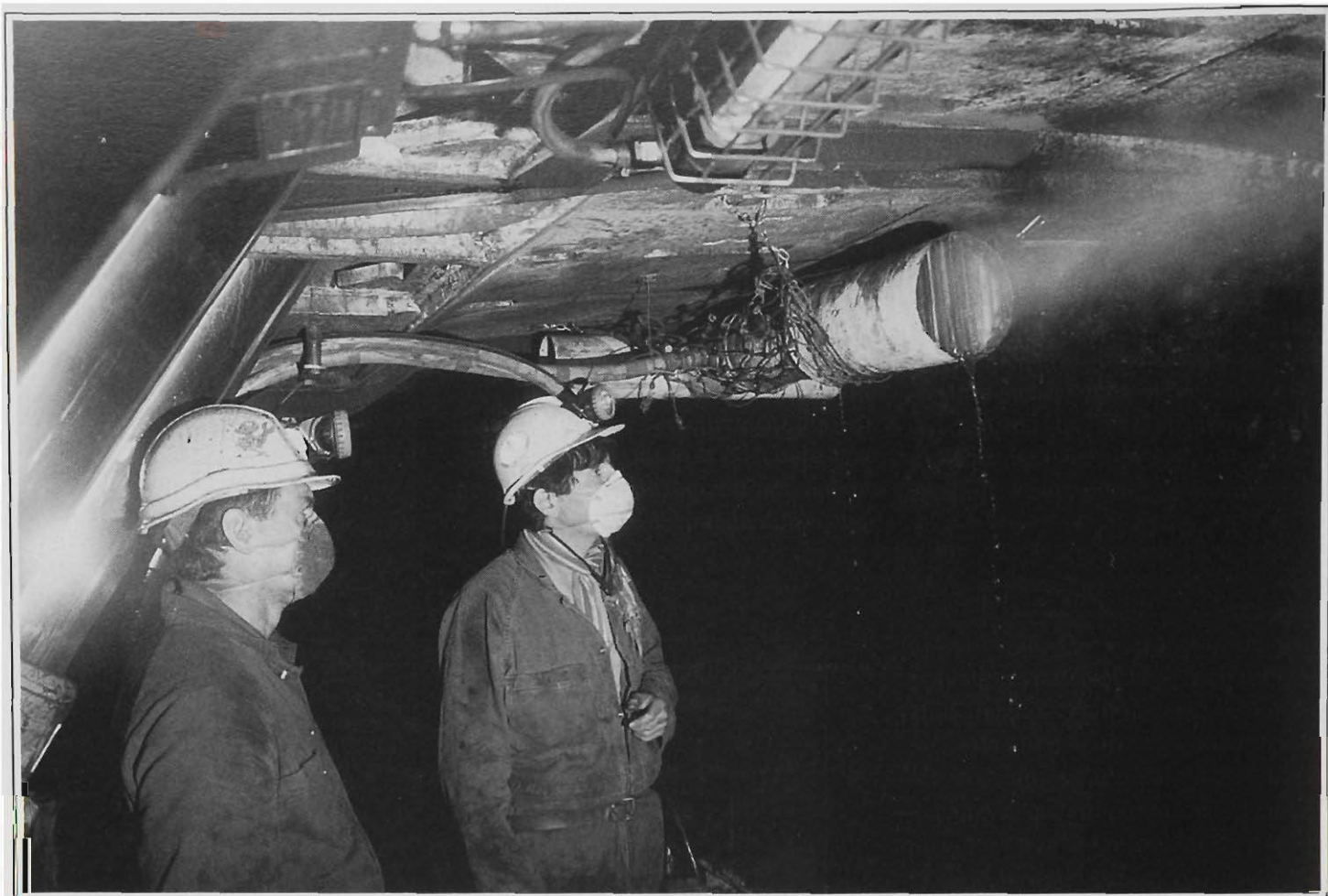
- Development of erection technology for large structures (ARC), virtually eliminating site work. Research on shape formation of reticulated space structures continued. The latest test, a model scale reticulated dome structure, was shaped from the flat position into a doubly curved dome by means of prestressing edge chords. The formation of the derived shape from the flat condition at ground level offers potential for significant savings in construction costs. Examples of use are for domes for sports stadiums, exhibition halls and other public buildings. Two fairly comprehensive series of tests have been conducted on circular and square hollow-section

struts-initially curved into the inelastic range. The data gathered from these pair-ended tests is being correlated with computer results, which are based on fundamental material tests for such elements. Several interacting non-linear material effects are present. One of the aims of the investigation is to determine the relative importance of these effects. Eventually, design rules will be formulated.

- Residual stress effect on fatigue (ARC), contributing to code modifications.
- Damage Analysis of Hard Coatings. The scratch testing of a range of coatings on different substrates has been

accomplished. The main coatings evaluated were titanium nitride deposited by PVD technology, proprietary sol-gel coating developed and patented by M Samandi and electroplated chromiim and nickel layers. The cohesive and adhesive failure of the coatings, as judged by acoustic signal and frictional force, have been thoroughly investigated using optical and electro-optical microscopy. The findings will be used to assess the validity of existing theoretical analyses and will form the basis for developing finite element methods.

- Damping of concrete, for vibration control of structures.



Seen here testing the prototype of the longwall dust extraction equipment at Tower Colliery are Ian Laird and Dr Naj Aziz, both from the Department of Civil and Mining Engineering. The picture opposite shows the ground equipment

Members: Dr N Aziz, Dr E Baafi, Dr I Porter, Professor R Singh (all from Civil & Mining Engineering), Mr A Depers, Associate Professor B Jones and Dr L Jones (all from Geology).

THE FOSSIL Fuels Group, which incorporates members of the Department of Geology and the Department of Civil and Mining Engineering, undertakes research in geological and mining engineering aspects of fossil fuels, especially coal, oil shale and petroleum. At present, the group has five specific projects in which research is carried out by the members and their postgraduate students. Projects are:

Dust control in coal mines

Under the leadership of Drs Aziz and Baafi, this project for 1992 attracted an external grant of \$76,000 from the Joint Coal Board and The Australian Coal Association Research projects; it is expected to attract funding also in 1993.

This project has important implications for the coal-mining industry in Australia and in the Wollongong area in particular, because of mine-orientated emphasis. Two PhD and one ME postgraduate students are currently enrolled in this work. Projects include longwall dust extraction, geological modelling of orebodies using the Octree technique and computer-aided feasibility studies of Indonesian coal deposits. A major project on the electrolytic enhancement of water particles for dust suppression in coal mines is being undertaken in collaboration with Prof Roxborough (University of NSW) and Common-

wealth Scientific & Industrial Research Organisation (CSIRO). The Key Centre for Mines provides the vehicle for this collaboration which is expected to be funded at \$85,000.

Gas in coal seams

This is an interdisciplinary study involving gas drainage, gas sorption and environmental aspect of gas and water in coal-bearing sequences. Dr Aziz is leader of the project and assisted by Dr Hutton. One postgraduate student is also involved but in the project will have external funding in 1993 for a PhD stipend and a number of applicants are being considered; the student will be supervised by Aziz/Hutton.

Characterisation of oil shale

This is probably the only project of its type presently studied in Australia. Funding received a significant boost in 1992 when an ARC grant for \$102,000

(\$36,000 each of 1992, 1993 and \$30,000 1994) was received. An Australian postgraduate scholarship was funded under the grant. This project has close cooperation with the three industrial companies currently engaged in oil-shale exploration and research in Australia.

Other studies during the year covered oil-shale characterisation and retorting behaviour, organic petrography of spent shales, characterisation and origin of cannel coals, all undertaken as collaborative projects with the Centre for Applied Energy Research (University of Kentucky, Lexington, USA). Four publications have been accepted for the 1992 Eastern Oil Shale Conference in Lexington.

Petroleum basins

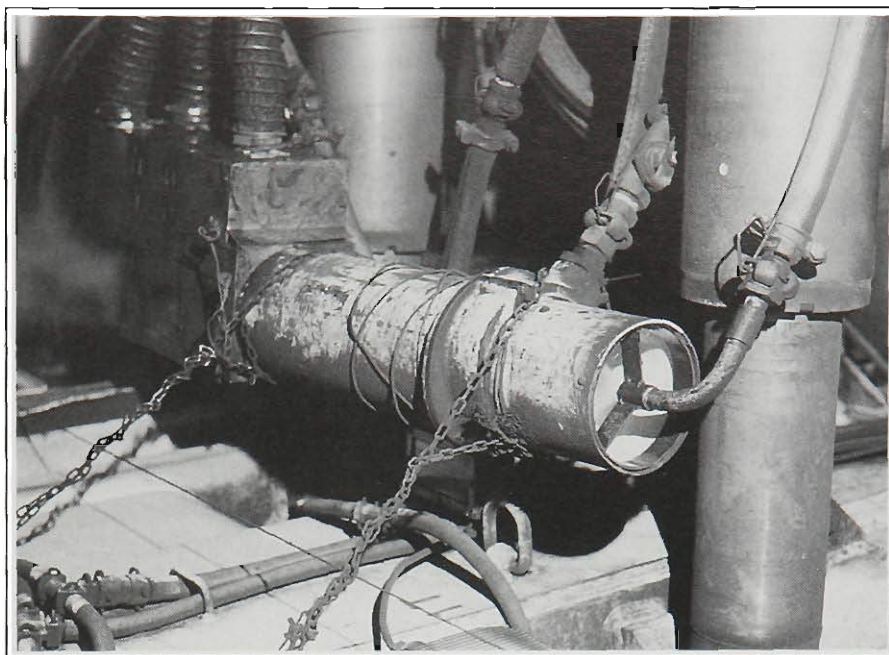
The number of postgraduate students dropped in 1992 after the graduation of five of them. The project still however has three postgraduate students and applications for 1993 enrolment have been received from five overseas students.

Several conference abstracts were written, three of them currently submitted to journals. The main thrust of the project in 1992 was the research of petroleum source rocks studies of Indonesian Tertiary basins and the Otway Basin of southern Australia.

Sedimentology and stratigraphy of coal sequences

This is one of the two major projects in the Fossil Fuels Group. It continues to attract a large number of overseas postgraduate students; presently six are enrolled and applications have been received from additional potential candidates.

Research was conducted into the sedimentology and stratigraphy of coal-bearing sequences in the southern Sydney Basin (New South Wales), the Galilee Basin (Queensland) and Indonesian Tertiary basins. Conference papers were presented to Australian, Indonesian and Canadian conferences.



The group intends to offer a PhD scholarship within the project in 1993, to consider aspects of roof strata and prediction of lithologies and mine conditions from geophysical logs.

Achievements

Postgraduate enrolments have continued to provide a strong base for research and the acceptance into the program of overseas students has been maintained and is setting the groundwork for collaborative research with institutions and government instrumentalities in those countries from which the students are attracted. The group continues to pursue a vigorous publication program and regularly presents papers at conferences.

The Key Centre for Mines provides a strong umbrella for collaborative teaching and research with the University of New South Wales and is instrumental in providing several scholarships for postgraduate study; it will provide \$20,000 to \$30,000 for a Sun Spark Workstation to enhance teaching of geostatistics. One of the strengths of the Key Centre is the rapid growth in a short courses; 22 were presented in 1992 and Wollongong academics took part in many.

Wollongong academics participated in these short courses: Geostatistical Ore

Reserve Estimation (Dr Baafi), Longwall Mining (Aziz), Mine Waters (Aziz). A training course on the Application of Computers in the Mining Industry was given to Indian engineers by Drs Aziz, Baafi, Porter and Prof Singh. Dr Aziz and Prof Singh were instrumental in organising the training course as well as giving lectures. Drs Baafi, Aziz and Hutton and Prof Singh gave lectures to a distinguished group of Chinese mining officials. Dr Aziz convened and gave lectures in the 11th International Conference on Ground Control in Mining in July.

Dr Baafi was session chairman of the 23rd International Conference on Applications of Computers and Operations research (Tuscon, USA), Dr Aziz is Deputy Director of the Key Centre for Mines, Brian Jones was Session Chairman of the Australian Geological Conference in Ballarat (January) and is also editor of the *Australian Journal of Earth Sciences*.

The future direction of the group is to use funds as seeding funding for initial-year scholarships and then to obtain external funding through the Australian Research Council/Australian Postgraduate Research Awards scholarships for continuation of the projects.

Members: Dr C Freeth, Dr R Lewis, Dr A Martin, Dr P Simmonds, Dr R Vickers and Dr C Zhang (all from Physics).

SEMICONDUCTING materials play a key role in current high technology and their application depends on a detailed understanding of their fundamental properties. Many of these properties are controlled by the incorporation of deliberately introduced impurities called dopants. There is still a great deal to be learned about the physics of dopants and their effects on the host material.

Over the past decade or so the development of epitaxial growth techniques, such as molecular beam epitaxy (MBE), has enabled alternating layers of different semiconducting materials to be grown one on top of the other, the layer thickness being controlled with atomic precision. The number of possible structures and variety of materials which can be grown in this way is enormous. The next generation of electronic and optoelectronic devices will be based on these layered nanostructures; indeed, some nanostructures, for example quantum well lasers, are already being mass produced. With the advent of MBE and the development of new semiconducting compounds it is clear that the field of semiconductor physics is still in its infancy.

Most of the work by this research group uses the techniques of optical spectroscopy to study impurities and their hosts. Details of the properties of these are revealed under the application of uniform magnetic, strain and electric fields. The electronic structure of important impurities in the archetypal elemental semiconductors, germanium and silicon, are the subject of several investigations. Two of the projects are examining the electronic and optical properties of some layered structures based on the compound semiconductor gallium arsenide.

(a) Far infrared studies of impurities in germanium and silicon

Absorption spectroscopy in the infrared and far infrared has proved to be a powerful technique for unravelling the behaviour of impurities and point defects in solids and in particular semiconductor and ionic crystals. The solid to be studied is exposed to infrared 'light' and the transmitted beam is deficient in energy at wavelengths that have been absorbed by the solid. For shallow acceptors in germanium and silicon these absorptions are very narrow in wavelength range and thus sharp spectral features are observed. A spectral analysis then can elucidate many of the physical interactions between the impurity and its host. The present report summarises some of the results that have been obtained over the past year and recently reported at the Fifth International Conference on Shallow Impurities in Semiconductors, Kobe, Japan and the Twenty-First International Conference on the Physics of Semiconductors, Beijing, China.

(i) Piezospectroscopy of singly ionised zinc in germanium and indium in silicon

A piezospectroscopic study has been completed of the main series of infrared absorption lines and Fano resonances (recently discovered by us) of singly ionised zinc (Zn^+) in germanium (Ge) and indium (In) in silicon (Si). This has permitted an understanding of a complex spectral feature of Zn^+ in Ge and a number of lines of In in Si. For the latter, it has permitted a differentiation to be made between the results of several theoretical calculations of the energies of two close, strong lines of this impurity. The selection rules for piezo-Fano effects have been deduced and the experimental results are shown to be in agreement with these rules.

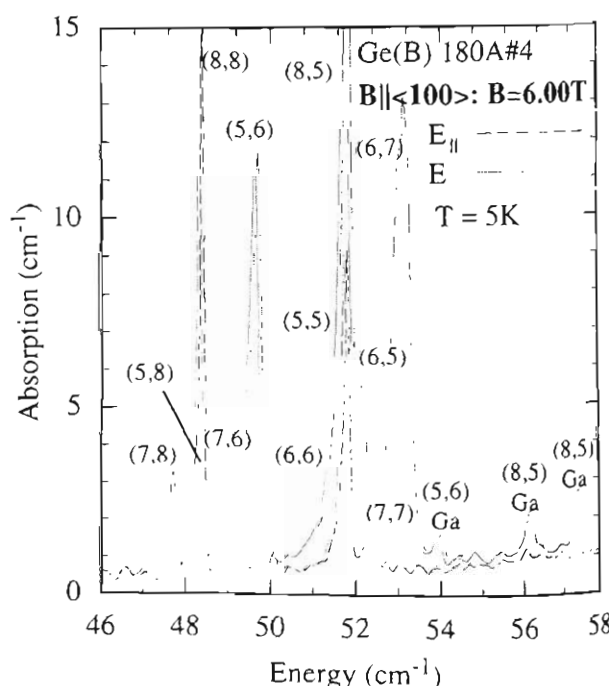
(ii) Zeeman and piezo-Zeeman spectroscopy of bound acceptors in group IV semi-conductors

The Zeeman spectra of boron impurity in Ge have been examined using magnetic fields (B) of up to 7T. This is the first study using such field strengths and gives definitive results for shallow acceptors in Ge. Comparison with the results of two very recent theoretical calculations shows that the experimental results favour one of these.

Zeeman measurements have also been made on Zn^+ and neutral Cu up to fields of 1.44 T. These results are significantly different for each impurity and different from those obtained for the simpler group III impurities.

The spectra of several group III impurities in Ge have been studied under the simultaneous application of a magnetic field and external force, F . Piezo-Zeeman spectroscopy and its related theory for shallow acceptors in group IV semiconductors was developed here. The results of the exact theory have been used to analyse the data to provide g -values for the energy states involved. The Zn^+ data

Figure 1. Zeeman spectrum of the G line of boron in Ge.



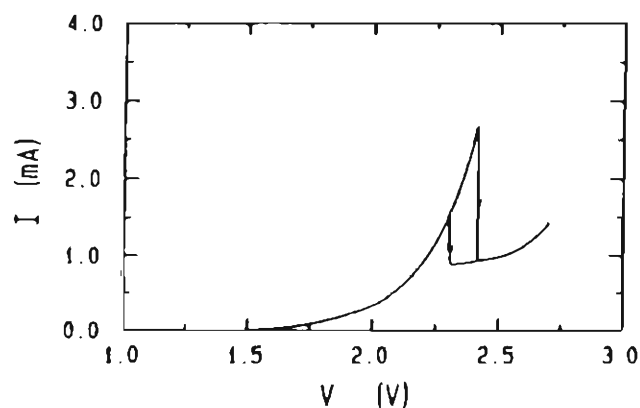
yield principal g-factors for the ground state which are significantly larger than those obtained for group III impurities in germanium while those of the excited states are similar. This technique has been applied to neutral copper (Cu) in Ge and is being extended to neutral Zn in Ge.

(iii) *Spectroscopy of Coulomb-related Landau states of shallow acceptors in germanium*

Landau levels are formed when the valence band states regroup under an external magnetic field. The magnetic field and Coulomb potential of the impurity combine to produce impurity states split off from the Landau levels. In the earlier work for $\text{Fl } |<111>$, no transitions were observed to states associated with the lowest three Landau levels, although six transitions were identified as Zeeman components of the A lines. In our earlier studies ($B < 1.2\text{T}$) these transitions had energies below the zero field ionization energy. It is now found at high fields, up to 7T, that at least four of these lines shift above this energy and undergo significant increases in intensity with increasing field. Two appear to form part of a new series of lines, arising at high fields, associated with the 2_1 Landau level. This level turns out to be predominantly heavy hole in character and therefore it is not surprising that high magnetic fields are needed before a series of Coulomb states attaches to this level. What is surprising is that this should happen for the 2_1 level before it does for the 0_0 level, which is a light hole level.

The remainder of the lines observed at high fields were also present at low fields. The energies of these lines appears to be the same as those observed in a photoconductive study. At fields greater than $\sim 4\text{T}$, the major part of the impurity absorption is due to lines whose final states are associated with the light-hole Landau levels.

Figure 2. Current-voltage characteristic of a resonant tunneling diode showing the bistable region between 2.3 and 2.4V



(b) *Optical and electrical properties of quantum well and resonant tunnelling diodes.*

Quantum well and resonant tunnelling diodes are part of a family of structures based on alternating layers of semiconducting materials such as gallium arsenide. The layer thickness is typically on a scale of nanometers and consequently the physics of these structures is governed by quantum effects. Appropriate choice of the semiconductor materials and their layer thickness gives rise to energy barriers in the structure. Electronic particles can be confined within these barriers if the width of the barriers is relatively large, forming a quantum well. Particles can tunnel through the thinner barriers of a resonant tunnelling diode.

Layered nanostructures can be engineered to have a wide variety of useful optical and electronic properties. For example, low noise high speed transistors and quantum well lasers are already being used on an industrial scale.

Photoluminescence and electron tunnelling spectroscopy have proved to be effective means for studying the electronic properties of these quasi two-dimensional semiconductor structures. The structures studied here have been grown using molecular beam epitaxy by collaborators at the Department of Physics, University of Nottingham and Telecom Australia.

(i) *Electrical and optical studies of intrinsic bistability in resonant tunnelling diodes*

Work on these devices has concentrated on a type of structure which has an

electrical characteristic (current vs. voltage curve) which exhibits a region of bistability; that is, over part of the characteristic there are two possible current values at a particular voltage (see Figure 2.). Both the structures themselves, and the physics involved in their operation, have great relevance to the field of ultrafast and optoelectronic devices.

An electronic technique for probing the region of bistability (which is normally inaccessible) has been developed. This has enabled the complete characteristic in the region of the bistability to be measured for one of these devices. Such measurements have not been previously reported and open up a wide area of experimental and theoretical work which can be carried out. Initially it is planned to extend these measurements to lower temperatures on this and other devices and also to examine the effects of strong magnetic fields using the Physics Department's 7T superconducting magnet. The effects of photocreated hole tunnelling on device behaviour will also be examined.

(ii) *Photoluminescence characterisation of hydrogen passivation in quantum well structures*

The efficiency of radiative recombination of energetic electronic particles is an important factor in optoelectronic device performance which can be degraded by the presence of impurities and defects. Hydrogen passivation of impurities and defects in (Al Ga)As-GaAs quantum wells has been studied using photoluminescence spectroscopy. Recent experiments demonstrate effective passivation of both bulk and interface defects in some samples.

INTELLIGENT POLYMERIC MATERIAL

Co-ordinator: Professor Gordon Wallace (Department of Chemistry), tel. 21 3127

Members: Dr N Barisci, Dr A Hodgson, Mr M Imisides, Dr W Price, Dr S Ralph, Dr C Too, Dr L Yuping (all from Chemistry) and Dr G Spinks (Materials Engineering).

DURING 1992 Intelligent Polymer Research Laboratory (IPRL) has further developed its international reputation as a leader in Intelligent Materials research. This is evidenced by invitations to present research findings at important international conferences and appointments to the editorial boards of new journals which are helping establish this fascinating area of research.

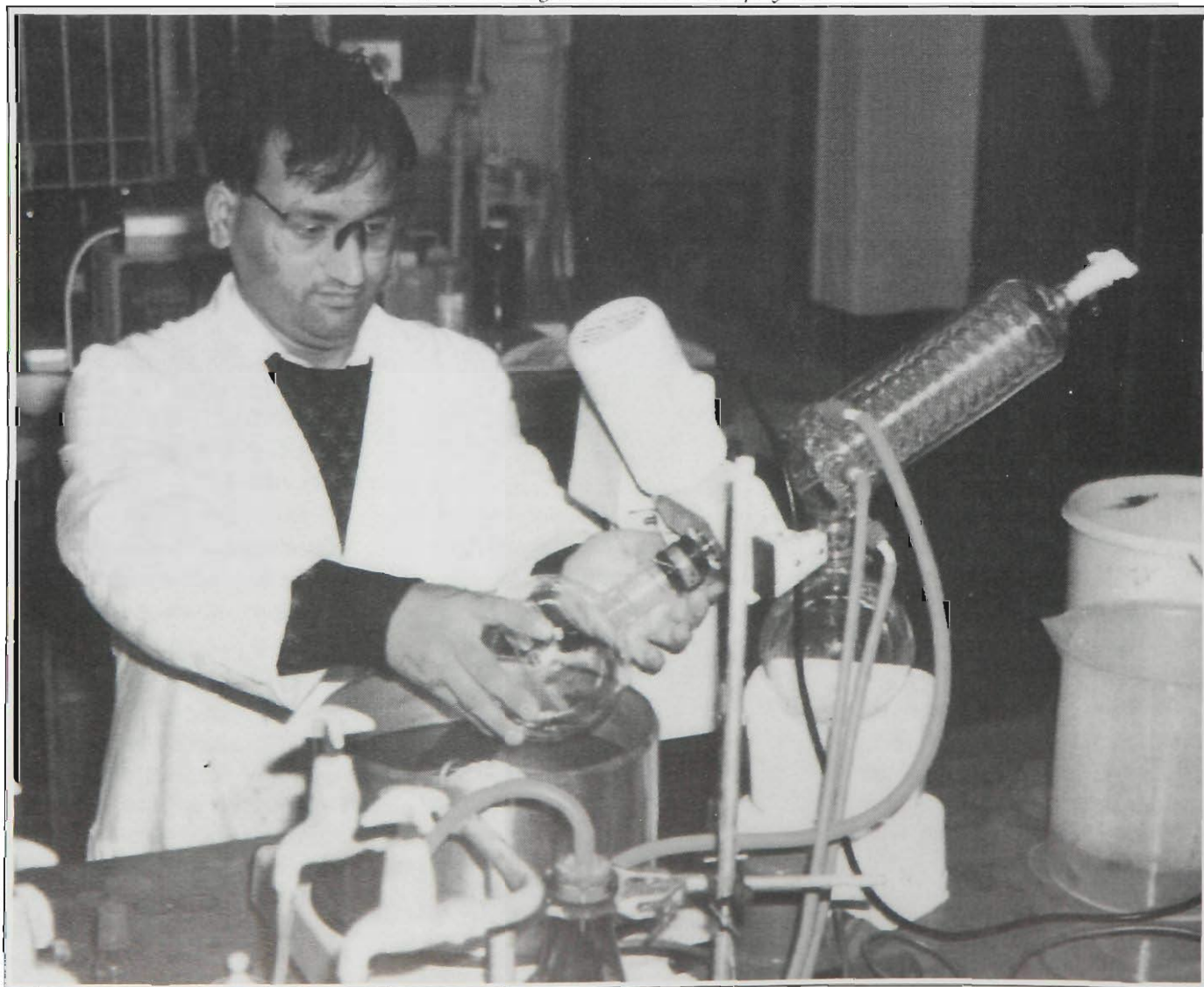
While these international accolades are welcome, IPRL has also continued to work on projects closer to home. Links with industry and other Australian research institutions continue to be strengthened. New collaborative research ventures with Australian Defence Industries (supported by an ARC Collaborative Grant) and the Sydney Water Board have been initiated. Work with CRA, BHP and Pasminco is continuing. Ties with UNSW and Commonwealth Scientific & Industrial Research Organisation (CSIRO) (division of Chemicals and Polymers) in both membrane and polymer science have been strengthened and the joint research expertise and facilities now available will enable the group to continue to break new ground

as it continues indeed to achieve success with colleagues at UTS in Polymer Processing and the University of Western Sydney, and with CSIRO (division of Food Technology) in Sensors Research. IPRL recognises that these research links are essential to continued success in this multidiscipline area. It is only through the establishment of strong multitiered research teams that the group can remain internationally competitive.

To ensure that this research momentum and IPRL's prominent position is maintained IPRL undertook an aggressive campaign to expand fundamental research during 1992.

A molecular building block approach

Staff in the Intelligent Polymer laboratory are involved in a range of activities, from monomer synthesis – monomers are the molecular building blocks used to create polymers



was adopted to the creation of intelligent materials – molecules are synthesised and assembled in an appropriate manner to deliver the performance specifications required of the final product.

This is already impacting on the group's work in Intelligent membranes where materials can be designed and developed to perform particular separations. Similarly new sensing systems can be designed and constructed from the molecular level.

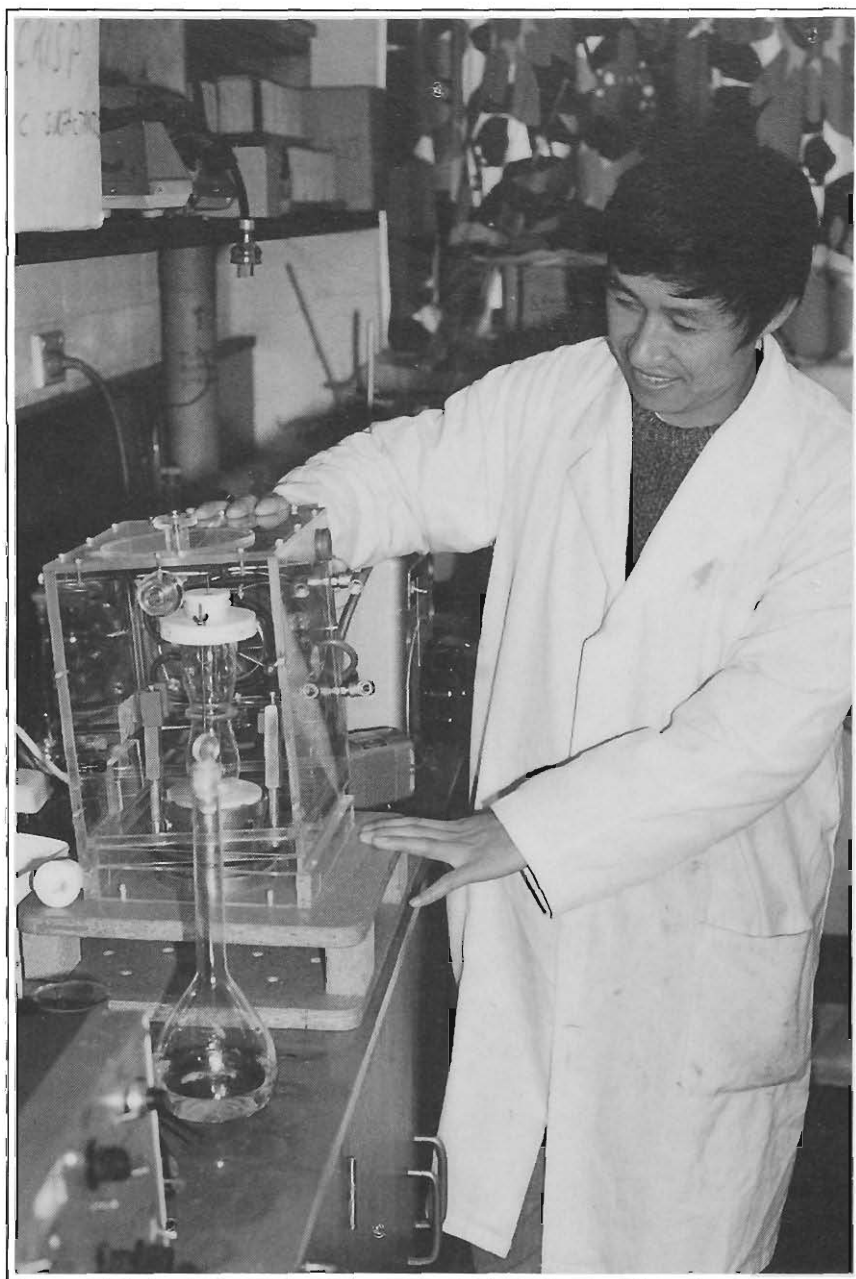
Other fundamental studies are:

- Molecular Imprinting – Techniques for imprinting polymer properties during synthesis,
- Electronic properties of polymers – Elucidation of molecular structure – electronic property relationships,
- Interfacial phenomena – Study of molecular processes at polymer solution interfaces, and
- Mechanical properties – Elucidation of Mechanical properties/Molecular structure relationships have also been initiated.

Implementation of these studies has required the development of new chemical characterisation tools capable of providing information on interfacial phenomena at a molecular level. This is now an area in which IPRL has significant expertise and facilities and is establishing an internationally recognised capability. These techniques allow us to probe the chemistries occurring at interfaces. Such an understanding at a molecular level promises to unravel many of the mysteries in areas such as molecular separations, sensing, biofouling, adhesion and material compatibility.

During 1992 interfacial characterisation techniques based on:

- Resistometry – a technique capable of *in-situ* measurements of resistance,
- Dynamic Contact Angle analysis – a technique to probe polymer wettability and the dynamics of the process,
- Quartz Crystal Microbalance – a technique capable of monitoring extremely small changes in polymer mass (pg) *in-situ*, and



Researchers also work at the development of new applications for intelligent materials, for example, improved metal-refining processes

- Inverse Chromatography – a technique used to probe specific molecular interactions at polymer interfaces have been developed. All have required substantial input from various disciplines including chemistry, electronics and materials engineering. The fact that these techniques can be used *in situ* and in real-time provides us with a molecular vision (although somewhat blurred at present) which enables molecular assembly and manipulation to be verified.

IPRL made significant advances in both the understanding and application of Intelligent Materials during 1992. The energetic research staff now look forward to continued development of its fundamental understanding and continued success in more challenging areas of application.

LABOUR HISTORY AND INDUSTRIAL RELATIONS

Co-ordinator: Professor James Hagan (Faculty of Arts), tel. 21 3369

Members: Ms J Castle, Mr C McGuffie, Dr J McQuilton, Dr W Mitchell, Dr A Wells (all from History & Politics), Associate Professor R Castle, Associate Professor R Markey (Economics), Dr A Frazer and Associate Professor K Hale (Law).

SEVERAL members of the Group have published significant books in Australian labour history since our 1991 report. Mr Henry Lee (together with Dr Stuart Piggin of Macquarie University) published *The Mount Kembla Disaster*, a book of some 150,000 words which examines the impact of the events of 1902 when Mt Kembla Colliery exploded killing 96 men and boys. Professor James Hagan (together with Associate Professor Ken Turner, late of Sydney University) published a *History of the Labor Party in New South Wales*, the first history of the Party to cover its entire first century. Together with Dr Andrew Wells, Professor Hagan also edited *The Maritime Strike: A Centennial Retrospective*, a collection of papers given at the Conference organised by the group to mark the centenary of the occasion and honour Dr Eric Fry, a founder and long-serving President of the Australian Society for the Study of Australian Society for the Study of labour history.

Rob Castle published the *Evaluation of Economic Ideas*, and with John Mangan (of the University of Queensland) edited the *Focus on Economics* series for Oxford University Press. Josie Castle published her short version of a *History of the University of Wollongong*.

Members of the Group also read a large number of papers on their research specialities at various conferences. Among the most significant of these was Associate Professor Ray Markey's paper on 'Race, Labour and Ethnicity in Australia, 1850-1900' which he read at the Centre for the Study of Urban Inequality at the University of Chicago. Andrew Frazer read his paper on 'Delimiting Industrial Law: Judicial Review



Professor James Hagan

and the New South Wales Arbitration System' to the Eleventh Annual Law and History Conference at Griffith University, Brisbane.

Meanwhile, work continues on a number of well-established major projects which are now nearing completion. With his Fellowship funded by the Transport Workers' Union, Dr Bradley Bowden was able to complete his manuscript of *A History of the Transport Workers' Union*, and the book will be launched early in 1993. Partly funded by the Building Workers' Industrial Union but also by the University, the Faculty of Arts and the Group, Dr Glenn Mitchell will complete his manuscript on a history of industrial relations in the building and construction industry by that time. Associate Professor Markey's book *In Case of Oppression: The History of the Labor Council of New South Wales 1871-1991* is also scheduled for publication in 1993. Associate Professor Ken Hale expects to publish the first book arising from his research into laws prohibiting sex discrimination in the work place early in 1993. Not so far advanced but running to schedule is Andrew Wells' research on the History of the Communist Party in Australia, a project for which both he and Professor

Stuart Macintyre (of Melbourne University) have been generously funded by the Australian Research Council.

The group has also attracted significant funding from other sources. The Reserve Fund has provided Dr John McQuilton and Professor James Hagan with a grant to develop computer-associated teaching and learning in history; and the Department of Employment, Education and Training has supplied Josie Castle and Professor Hagan with \$150,000 to be shared with two members of the Faculty of Education in devising and implementing a program for the re-training of teachers of Australian history.

The Minister for Industrial Relations, Senator Cook, has granted the Group \$27,000 to organise an International Conference on a historical approach to the comparative study of industrial relations in Australia and Japan. This is the second of two important first ventures for the Group. By contracting with Five Islands Press for the printing of *The Maritime Strike: A Centennial Retrospective*, the group became its own publisher. With the organisation of the conference it has deliberately begun to extend its research to encompass international comparison. The teaching with which Group members are associated will reflect that developing interest.



75

Members: Dr E Booth, Associate Professor B Cambourne, Ms B Derewianka, Ms C Fox, Mr N Hall, Ms J Hammond, Dr P Harris, Dr J Jones, Ms J Tresize, Ms J Turbill, Ms J Wright (all from Education), Dr A Cranny-Francis, Dr L Ravelli (English) and Dr F Yuen (Nursing).

FORMED in 1992, the group consists of 15 members from the Education Faculty, Department of English and Department of Nursing. It is concerned with research that is geared toward the role of language in learning and associated learning environments, and the equity issues that can be examined within these two foci. Results of this research have been presented throughout Australia and in New Zealand (Wright) Britain (Jones, Winser), the United States (Hammond, Jones, Cambourne, Turbill) and Canada (Winser).

Language-based studies

Harris has continued her study of children's reading development in the first three years of school. She has found that children became increasingly aware of the need to meet institutional requirements correctly and that their subjectivity as readers and learners was being strongly shaped. There was an increasing awareness of intertextuality that is closely related to success in reading development. Related to this work is Winser's study that is developing a socio-linguistic model of reading, one which takes into account social and linguistic factors in readers and the reading task.

Hammond has also been studying literacy development in younger students, particularly the effect of metalinguistic awareness on their writing. The data collected from classroom discourse is revealing that an explicit awareness of language functioning contributes positively towards success in literacy development.

Tresize has studied the construction of emotions in children's literature, using studies in memory functioning as a basis for analysis of children's picture story books. She contributed to the development of training materials for a literacy learning project, and is also engaged in a study that is showing how parent-teacher-child relationships are historically constructed in the educational discourses of some popular media.

Derewianka's work has dealt with the important link between primary and secondary school; her longitudinal study of language development the transition from childhood to adolescence and have shown that there is a syndrome of emerging language proficiencies which demonstrates the young adolescent's ability to gain control over the language of technicality and abstraction.

A number of studies have focused on secondary school. Cranny-Francis (Department of English) has studied the processes by which secondary school readers interpret literary texts. She found that they receive very little support in learning how to respond to these in ways

that schools regard as legitimate. Winser, Ravelli and Wright have begun a three-year evaluation of a major project in secondary writing across the curriculum; preliminary results show that Science and English teachers who are aware of the way that writers can be explicitly supported in their use of language in writing can bring about improved writing skills in students. Cranny-Francis, Winser and Wright's Australian Research Council (ARC) study of success and failure in Secondary English is in its first phase, with school documents having been analysed and a sample of teachers interviewed. A picture of teachers' expectations about students and their subject is emerging, indicating that they are influenced by traditional literary models of English and facilitative modes of teaching where self-expression is valued. Cambourne and Turbill (together with Hall and Wright) are examining the language of secondary school maths teaching and have developed the first phase of the study through selecting and interviewing a group of successful maths teachers.

Ravelli (Department of English) is conducting a pilot comparative study of writing requirements in different University disciplines. Aspects of oral and written language in the adult tertiary education environment are being explored, with particular reference to the literacy requirements of this University.

Fox's interests are in inter-cultural theory. Her work in the development of a theory of inter-cultural communication applicable to Australian contexts and classrooms is showing a clear need for critical analysis and an interdisciplinary approach. Winser's language curriculum study concerns the ways language development theory is used in the development of state and national language curricula. Early findings indicate that few state curricula are based on any coherent theoretical framework, and that there is only fragmentary use of theory in the national documents. Finally, Wright's research on teacher talk and gendered subjectivity has demonstrated that for the schools in her study, many of the girls are positioned and

position themselves as marginal in relation to physical activity and physical education.

Learning environment studies

Jones has been examining high-achieving junior secondary students in maths and science. Analysis of over 1,000 students has revealed that gender differences outweigh other differences, such as school type, in the students' perception of their performance in these two subjects. In the nursing field, Yuen (Department of Nursing), has been examining the clinical environment that may influence nursing staff attitudes towards continuing learning. He has conducted exploratory case studies to determine the extent to which desired educational changes occur and where improvements could be made to the educational process. Neil Hall's work in teaching mathematics to primary school students through procedural analogy is concerned with the development of an approach to teaching mathematics through the use of concrete embodiments. A second study concerns the teaching of mathematics to pre-school children through computers; it has found that meta-cognitive teaching styles are superior to the traditional styles of teaching commonly used in pre-schools.



Members of the group, from left are Dr Anne Cranny-Francis, Ms Beverley Derewianka, Ms Jenny Hammond and the Co-ordinator, Dr Bill Winser

Equity studies

There have been equity aspects in most of the above studies, but these have been addressed directly in King, Kyle and Wright's study. They are completing their report for their Evaluation and Investigations Project examining all secondary Link Programs funded by the Department of Employment Education & Training (DEET) in Australian universities. The study will provide principles and guidelines for future equity programs and will also place the evaluation in the context of current discourses

and practices associated with equity in Australia. Booth's work in the Secondary Schools LINK program has demonstrated that it has positively changed the perceptions of the targeted (low SES, NESB and Aboriginal) Year 10 students to consider a tertiary option after secondary school.

External funding

\$143,250 has been received from the ARC and from DEET and NSW Department of School Education sources.

MANAGEMENT STRATEGY AND ORGANISATIONAL CHANGE

Co-ordinator: Dr Trevor Williams (Department of Management), tel. 21 3754

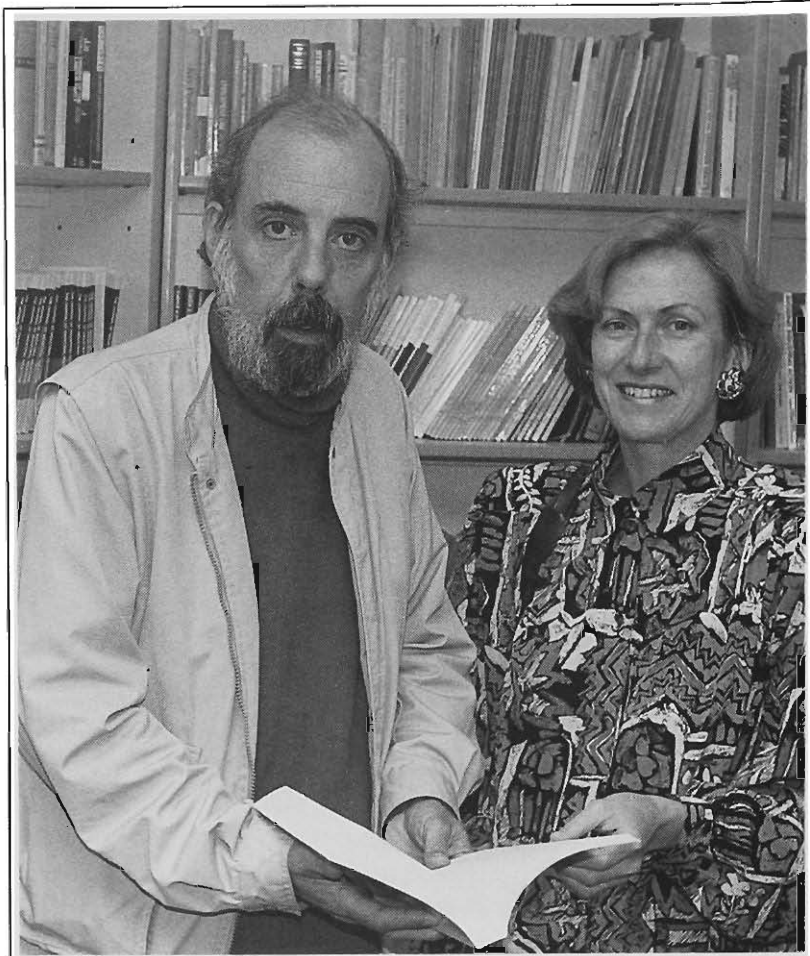
Members: Dr M Jabri, Mr A Naughton, Professor G Palmer, Associate Professor P Paterson, Dr A Sim, Mr M Zanko, (all from Management), Dr S Little and Associate Professor G Winley (from Business Systems).

AIMS OF the group are to identify and research important relationships between external change, strategy development and organisational change in the areas of production operations, finance, human resources, marketing, and information systems in organisations.

Most projects largely achieved their original objectives in the first three years, and there has been a substantial increase in Group membership. In February 1992 a full day conference was held at which members informed each other about the progress, current status and future directions of their research, explored possibilities for future collaboration, assessed how new research relationships might affect the existing project teams, and identified the next steps towards development.

Members concluded that this review did not indicate any major change in the existing project configuration. The Group is well advanced towards establishing an international reputation in the areas of first-mover advantage and competitive strategy, foreign exchange risk management, employment relationships and human resource management, inter-organisational relations, organisational culture and change, services marketing, and information systems development in organisations. The research interests and attainments of new members complement and extend the existing research activities.

To 30 August 1992, members of the Group produced 55 refereed publications for the year. This compares favourably with the 119 refereed publications which the Group produced during its first three years. The Group obtained its first Australian Research Council (ARC) Large Grant which was



Dr Trevor Williams and Professor Gill Palmer, a newcomer who has brought an international reputation and research leadership to the Group

awarded to Dr Trevor Williams and there has been a substantial effort to increase external competitive funding. The number of postgraduate research students associated with the Group increased and significant further increases are expected in 1993.

The Group's external reputation and linkages were considerably enhanced through the Third National Conference on Information Systems, hosted by the Department of Business Systems in October. Most of the Department's academic staff and postgraduate research students are members and associates of the Group, and several Group members from the Department of Management presented refereed papers and panel sessions to the conference.

The Group is strengthened by the addition of six new members. Professor Gill Palmer brings an international reputation in research and research leadership which will greatly benefit the Group.

Members: Dr S Boutcher, Dr M Brown, Dr P Milburn, Ms J Steele (all from Human Movement Science) and Professor C Morse (Nursing).

DURING 1992 the Department of Human Movement Science initiated a multi-disciplinary, longitudinal research project to investigate the physiological concomitants of ageing, the health implications of such changes, and the possible role of habitual physical activity in minimising age-related dysfunction. This project, which involves five members from the disciplines of anatomy (Dr Mark Brown), biomechanics (Dr Peter Milburn and Ms Julie Steele) and physiology (Dr Nigel Taylor) and psychophysiology (Dr Steve Boutcher), is designed to address three basic questions: (i) What are the functional differences between habitually active and inactive aged Australians? (ii) Are these functional differences markers for changes in the health status of the aged? and (iii) Can we modify the functional changes that occur in the aged, to improve the quality of life of the elderly?

The research group is following a long-term, three-phase research plan. During phase one (1992-93) group members are targeting research towards the first two questions, and are focusing upon gaining preliminary information from within their own areas of interest: (i) cardiovascular function; (ii) changes in gait patterns; (iii) neuromotor control of movement; and (iv) respiratory function. Phase two (1993-94) shall involve cross-sectional data collection across both age and physical activity spectra. The final phase (scheduled to begin in 1994), shall follow a longitudinal design, where the physiological status of chronically sedentary, elderly subjects shall be studied over a 12-month period during exposure to a variety of exercise intervention programs.

Postgraduate research

During 1992 six research students were partially sponsored by the group, and have been directly involved with research projects related to ageing. Three of these students shall complete their thesis requirements during 1992. Glenn Doney (MSc), working with Dr Mark Brown, has been studying the relationship between electroencephalograph waveforms and movement preparation in the elderly.

Roger Lewis (Honours), also studying with Dr Mark Brown, has been investigating age-related changes in motor reaction times. Dean Stocker (Honours), working with Dr Steve Boutcher, has examined cardiovascular responses of young and older males to tension and volume loading of the myocardium.

During 1993 several students will undertake thesis research within the group theme. Tara Bube shall undertake her Masters research, working with Dr Nigel Taylor, investigating changes in respiratory function across both chronically sedentary and active age groups. Alan Carmen (Masters research) shall study gait patterns with Dr Peter Milburn. Glenn Doney and Roger Lewis will enter the PhD programme, supervised by Dr Mark Brown, and will continue studying neuromotor dysfunction accompanying ageing.

Applied Physiology Research Laboratory.

Age-related perturbations to respiratory function may occur at any point between the sites of pulmonary gas exchange and the utilisation of oxygen at the cellular level. During 1992 preliminary research projects have focused upon changes to peripheral and central respiratory function accompanying ageing. Specifically, projects have compared pulmonary function during exercise transients in chronically sedentary adults, with specific attention towards peripheral indices for changes in gas exchange function; and arterial desaturation during progressive incremental exercise in the aged, as a means for the assessment of central cardiorespiratory limits to exercise tolerance in ageing adults.

Biomechanics research laboratory

Human gait is one of the most common but more difficult habitual movement patterns that we learn. Quantification of the determinants of human gait provides an important clinical tool for the analysis of normal and pathological motion. Research being conducted within this laboratory, in conjunction with the Rehabilitation and Geriatric Unit at Port Kembla Hospital, is aimed at studying changes in gait patterns in patients with osteoarthritic knees during the course of rehabilitation.

Cardiovascular research laboratory

Generally, the ageing cardiovascular system demonstrates a slower and less efficient response to increased myocardial demand. However, the pattern of the cardiovascular response in the aged is poorly understood. Thus, the focus of this laboratory is to examine central and peripheral haemodynamic responses to exercise stimuli. Three research projects are scheduled to be completed over the next eight months: (i) The ageing cardiovascular response to static and dynamic exercise; (ii) Cardiovascular responses to exercise stimuli in habitually active elderly subjects; and (iii) Differences in cardiac function between active and sedentary elderly subjects.

Neuromotor control research laboratory

The research theme of this laboratory deals with the effect of ageing on the control of skilled movement. The general aim is to establish neurophysiological mechanisms for age-related decrements in movement speed and movement accuracy, through an analysis of bioelectric waveforms (specifically electroencephalograms and electromyograms). Projects nearing completion have studied the relationship between muscle activation rates and age-related increases in motor reaction time, and the characterisation of muscle activation patterns in both elderly and young populations.

PUBLIC HEALTH RESEARCH

Co-ordinator: Professor Dennis Calvert (Department of Public Health & Nutrition), tel. 21 3463

Members: Ms D Condon-Paoloni, Professor C Ewan, Ms M Harris, Associate Professor R Harris, Dr L Harrison, Professor D Hindle, Professor R Hodge, Dr R Jayasuriya, Ms J McArthur, Mr P O'Halloran, Mr B O'Neill, Ms L Tapsell, Mrs H Yeatman (all from Public Health & Nutrition), Professor D Griffiths (Mathematics), Ms R Griffiths, Mrs B Tooth (Nursing) and Professor M Wilson (Geography).

PUBLIC HEALTH is a heterogeneous discipline area, and accordingly the research comprises several sub-groups: Social Health and Nutrition; Health Services Delivery and Evaluation; Mental Health; and Epidemiology and Environmental Health. There are numerous links between the research

being carried out by members of different sub-groups. Some broad areas of research encompass several of the sub-groups, especially the *National Reference Centre for Continuing Education in Primary Care* which is in the early stages of formation. Overall the group has attracted considerable research funds.

Research contributing to the National Reference Centre for Continuing Education in Primary Care

The group already has significant strength in General Practice research, with a number of projects under way. Other research activities in this area of primary care have centred on establishing the educational needs of rural primary care practitioners (a report has been completed), urban primary care practitioners (current), and the current

status of specialist services in rural areas (report completed).

A group involved in teaching in mental health is also carrying out an evaluation of mental health services in several Health Services. The point at issue is the effectiveness of current attempts to treat people with mental illness in the community rather than in a hospital, a policy of considerable importance in health. This research is in its formative stages. Financial and logistic support from Health Services has been gained.

Social health and nutrition

The last 12 months have represented the establishment phase of this sub-group. Initial funding submissions have been successful (\$76,000 to June 1992). Several research projects have begun in the past year, including an eating disorders survey of undergraduate students at this University (a paper is being prepared); a study of client-provider interactions in dietary counselling; a study on the cultural basis of food choices; the development of professional practice; and funding has been received for the Illawarra food and nutrition strategy and a Project Officer employed. Other grant submissions are under development. A number of the Department's post-graduate students have been involved in research projects.

Health services management and analysis

In order to achieve equity of resource distribution (a major aim in Public Health) we need to know much more about the cost, efficiency and efficacy of health services and about health needs.

Three members of the Department of Public Health and Nutrition, from left, Professor Dennis Calvert, Mr Rajeev Daniel and Mrs Barbara Meyer, are seen observing how proteins can be separated using Fast Performance Liquid Chromatography at the recently opened Medical Research Unit (MRU) at the Illawarra Regional Hospital, Wollongong campus. The main area of research carried out at the MRU are diabetes and heart disease



Significant research funding is accruing through case-mix studies (ie, studies detailing the population's offered services, and the kinds of services offered) and educational and management programs (eg, a computer-based management simulation educational program, a computer-based nursing care plan program). Current health problems (eg, patterns of AIDS-related illness, care and related expenditure) are analysed.

The group has performed strongly, submitting 10 grant applications, being awarded six grants, completing and reporting progress from which publications are now in preparation. In addition, the major achievement has been the consolidation of the reputation of the University of Wollongong as a credible centre for research in health services delivery and evaluation.

Mental health

Current projects include evaluation studies of psychiatric rehabilitation in the Illawarra and rural NSW being carried out in collaboration with Regional Health Departments. A five-year controlled study comparing two forms of community intervention to reduce relapse with schizophrenia is in progress. This is a continuing collaborative project

with University of Sydney and the Northern Sydney Area Health Service. Other studies focus on improving staff morale and retention in rural mental health services, through innovative provision of education and support, and workplace reskilling of rural mental health workers. One major project is discussed above under *National Reference Centre for Continuing Education in Primary Care*.

Epidemiology and environmental health

A variety of studies in epidemiology include studies on the relationship between social factors and risk factors for coronary heart disease (National Health & Medical Research Council), studies in asthma management and studies on child injury.

Environment Health, with members of the Departments of Geography and Economics, is proving successful in influencing national policy in particular areas (eg, the proposed introduction of Health Impact Statement for new major developments). Some work in environmental health is carried out in collaboration with the Public Health Unit of

SOFTWARE ENGINEERING AND INTELLIGENT SYSTEMS

Co-ordinators: Professor Fergus O'Brien (Department of Computer Science), tel. 21 3859 and Dr Phillip McKerrow (Department of Computer Science), tel 21 3771



Professor F O'Brien, Mr L Ohlbach and Dr J Gray discuss the development of the Pilot Aid System for the Maritime Services Board (MSB) at Port Kembla

Members: Mr P Castle, Associate Professor G Doherty, Mr J Fulcher, Dr J Getta, Dr J Gray, Associate Professor N Gray, Dr P Nickolas, Dr I Pirie, Mr G Stafford and Dr A Zelinsky (all from Computer Science).

THE SOFTWARE Engineering and Intelligent Systems Research Group was formed at the beginning of 1992. It focuses the work of 13 members of the Department of Computer Science into the two themes, Software Engineering and Intelligent Systems.

The Telecommunications Software Research Centre (TSRC), a Telecom, funded centre, is the major research group within Software Engineering. The research concentrates on the software re-

quired to support the proposed advanced telecommunication service, Universal Personal Telecommunications (UPT). UPT is based on the concept that a personal identifier will be used by individuals for the purposes of communication, rather than just a telephone number. UPT raises major issues of identification, security, billing and the use of various media such as fax or electronic mail, as well as voice.

TSRC is also becoming increasingly involved in the international design effort co-ordinated by Bellcore, USA, for a new approach to advanced telecommunications services. This is a five-year program that will go beyond TSRC's current three-year funding. TSRC has just passed the formal first-year review by Telecom, and the direction of UPT related software confirmed.

The SITA Neural Network project is the

major research group within Intelligent Systems, and is funded on a three-year basis by SITA, the global airline data network.

The project concentrates on the real-time recognition of faces using neural network techniques, plus associated statistical techniques. The objective of the research is eventually to produce a system for routine use in airports to provide extremely rapid recognition of faces of interest.

It is an ambitious project that breaks new ground in the use of neural networks for recognition, and in the classification, storage and retrieval of face characteristics.

Two other project areas within the group are in computer-aided learning (CAL), and in robotics and ultrasonics. The CAL project is concentrating on the research

needed to automate the teaching of first-year computer science subjects, specifically for the summer session.

The robotics and ultrasonic area has been very successful in researching the use of ultrasonics for mapping, echolocation, and robot navigation. This research is supported by the French company, Thomson Sintra Pacific, and through the support by the Japanese Government agency, MITI, for a senior researcher, Dr Alex Zelinsky, to spend two years with the Japanese MITI Electrotechnical Laboratory in Japan.

During 1992, the Department of Computer Science has been joined by Professor Jenny Seberry and her group in Computer Security and cryptography.

The group comprises four staff researchers, and four research assistants and has been in being for a number of years. The research undertaken by the group has earned it an outstanding international reputation, covering all the main areas in computer and communications security.



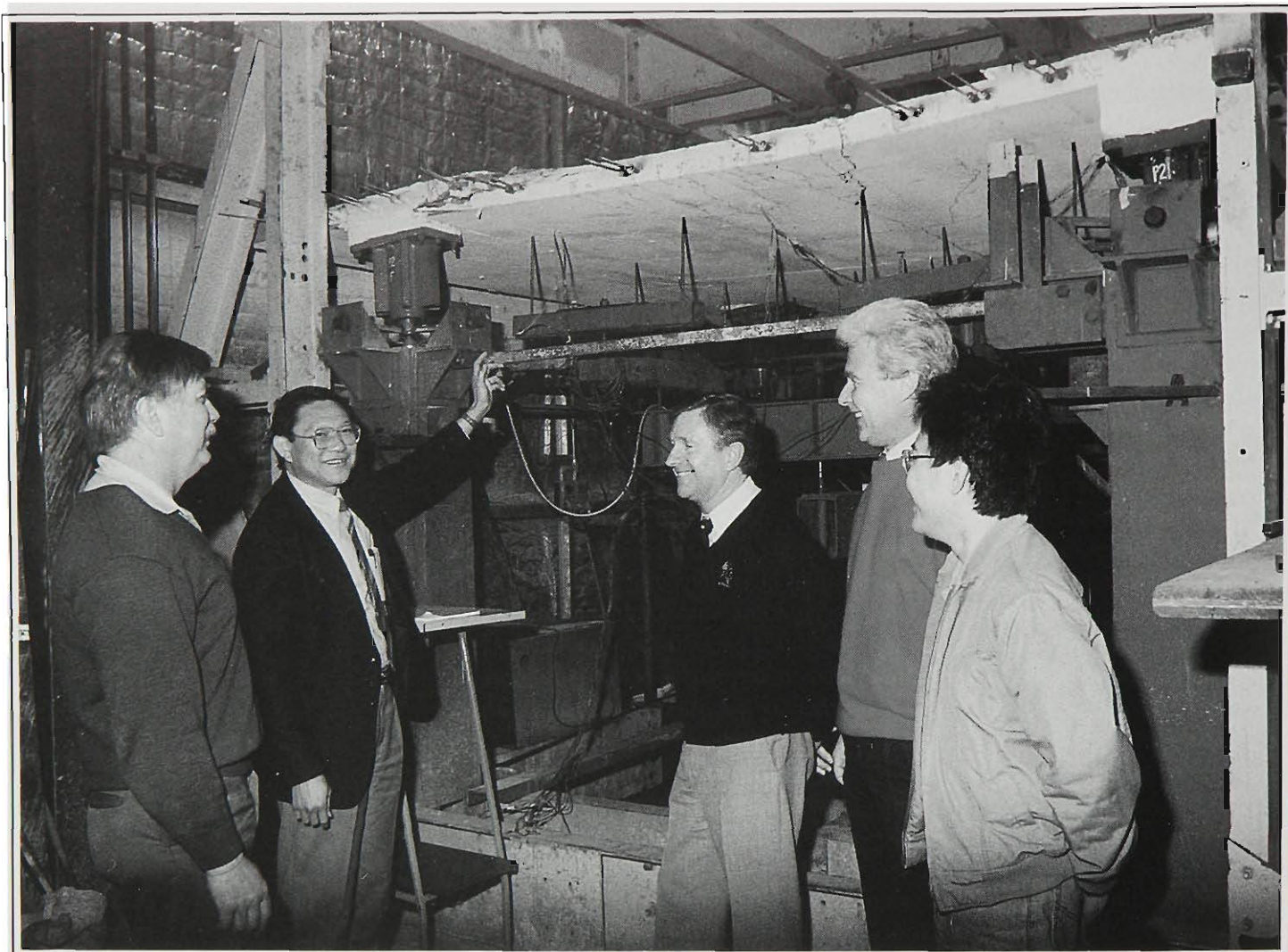
With Professor Fergus O'Brien (left) in this picture are Associate Professor Neil Gray, Dr Marilyn Cross, Bernhard Humm and Dr Janusz Getta

The group has been working in cryptography including the use of secret and public keys, and the design and testing of cryptographic primitives.

Other areas include authentication, secret sharing, and security issues for

databases, computer communications and operating systems.

This research is currently supported through a set of ARC grants. For 1993, it is proposed that this group form the nucleus for a University Research Program.



Group Co-ordinator Associate Professor Loo (second from left) seen here explaining the failure characteristics of a pre-stressed flat-plate model to colleagues; from left they are Mr N Gow, Associate Professors M J Lowrey and D M Montgomery and Mr C L Chiang

Members: Associate Professor M Lowrey, Associate Professor D Montgomery and Dr Y Wong (all from Civil and Mining Engineering).

THE Structural Engineering and Construction Research Group concentrates on experimental studies of large-size structural models and the applications of computers in the area.

Punching shear strength of concrete flat plates with spandrel beams

A concrete flat plate is an assembly of two types of structural components: the floor slab supported on rows of columns. To improve the structural efficiency of flat plates, spandrel beams are often cast monolithically around the

perimeter of the slab. For economical and aesthetic reasons, the use of flat plates in multistorey building construction is popular worldwide. The procedure for the bending design of flat plates is relatively well-established and its accuracy is good. However, the reliability of the various methods (including that recommended by the Standard Association of Australia) in predicting the punching shear strength of concrete flat plates was doubtful.

To investigate this problem, a three-year project supervised by Associate Professor Yew Chaye Loo, was supported by the Australian Research Council. Completed in 1991 it dealt with the strength of reinforced concrete flat plates. Two papers have been published internationally. The first summarised the strength test results of nine half-scale

reinforced concrete models; the second presented a new analytical procedure for the prediction of the punching shear strength of reinforced concrete flat plates with spandrel beams. The new method was shown to be superior to the Australian Standard procedure. The latter, at times, could be grossly unsafe in application.

As a result of the work on the reinforced concrete system, the Australian Research Council continued its support for a second three-year project which now deals with the pre-stressed, post-tensioned, concrete system. The project also enjoys material and technological support from the construction industry. So far, two half-scale post-tensioned models, each weighing approximately five tonnes, have been tested to destruction. Data analysis is in progress

and an attempt is being made to extend the prediction method to encompass prestressed concrete flat plates.

Computer software for structural design

Structural design often involves tedious computational tasks. The entire procedure for designing a simple structure includes determination of the correct loads; selection of the supporting conditions which should be as close to reality as possible; the use of analytical methods; calculations of geometrical and physical properties of the members; and checking the strength and serviceability requirements of various design codes. From the determination of loads to the selection of members, many cycles of trial and error iteration are required for the achievement of an adequate and economical design. Optimisation can be affected by many factors and sometimes it cannot be easily achieved.

Computers are now widely used in structural design and, with the aid of specific software, can improve the speed and accuracy of the design process. Most structural design software has however been developed to mimic the approach encompassing trial and error cycles. The major shortcoming of using this type of software is that for a given structural configuration and with known material and section properties there is no way of quickly determining the dimensional limits of the structure.

Dr Yen Wen Wong is currently conducting a research project on developing a different type of structural design software, that will create a data base for several types of structures which can be used for rapid prediction of the dimensional limits of a given type of structures.

Interactive computer training for the quarry industry

During the past year, Associate Professor Denis Montgomery instigated a project funded jointly by the New South Wales Education and Training Foundation, the Institute of Quarrying, the

Australasian Slag Association and several industrial companies. The purpose of the project is to provide interactive computer training for safe production with bins, conveyors and crushers within the mineral processing, materials handling and engineering construction industries.

Several computer-based training modules have been developed. These cover various aspects ranging from specific incidents which concentrate on safety practices and remedial action, to general information relating to theory, design and use of bins, conveyors and crushers. The modules are designed for use in industrial areas, and training program packages will be supplied to NSW companies for field testing. When initial field trials are completed, modifications will if necessary, be carried out before the final training modules are distributed to the relevant industries.

Educational software for structural mechanics

Work by Associate Professor Max Lowrey on development of educational software for structural mechanics has advanced in two separate directions.

During 1992, Version 5 of the PC-graphics simulation package *Animated Vibrations* has been completed, and released for student evaluation ahead of general distribution. This latest update includes new topics such as damped vibration absorbers and three-storey shear frames, together with enhanced options including a full range of damping values and triangular shock pulse excitation. Its release follows further acceptance of the package both within Australia and overseas, resulting in a very favourable reception as the subject of a feature article in the US-based *Shock and Vibration Technology Review*. As a consequence of that review, a new distributorship for the US market has recently been established in California.

The other project, began during the year, is concerned with the development of PC programs for the 'exact' analysis of orthotropic structural systems such as folded plates and box girder bridges.

As educational software, the programs will serve to provide useful benchmark results against which alternative finite element solutions may be evaluated. Work on the main modules of the initial programs is well advanced; proposed work will be concerned with development of essential pre- and post-processing modules.

THE TASMANIDES

Co-ordinator: Dr Chris Fergusson (Department of Geology), tel. 21 3860



PhD student Tim Green on the outcrop in the Anakie Inlier, 20 km south west of Clermont, Central Queensland

proceeded in collaboration with the Geological Survey of Queensland who undertook initial mapping in the region and provided base maps for detailed work. Many samples were collected for study to provide data on the depths of burial of the rocks (Tim Green and Group Metamorphic Petrologist Dr Bryan Chenhall) and on their age (Tim Green and Dr Paul Carr using previously established links with the Centre for Isotopic Studies at CSIRO, North Ryde). Results of this project may well have important implications for the recent hypothesis that over 600 million years ago eastern Australia, then part of the supercontinent of Gondwana, was joined with western North America before the opening of the ancestral Pacific Ocean.

Other projects have been continuing. Results of collaborative research on metamorphism of calcareous rocks between Dr Chenhall and A Mazaheri (PhD student) are presently being prepared for publication.

Several papers on the geology of the northern New England Fold Belt are in progress (Dr Fergusson in joint work with associate members Associate Professor R A Henderson and Professor E C Leitch) and other material requires laboratory analysis before the results will

Members: Dr P Carr, Dr B Chenhall, Associate Professor B G Jones, Dr J Pemberton and Associate Professor A Wright (all from Geology).

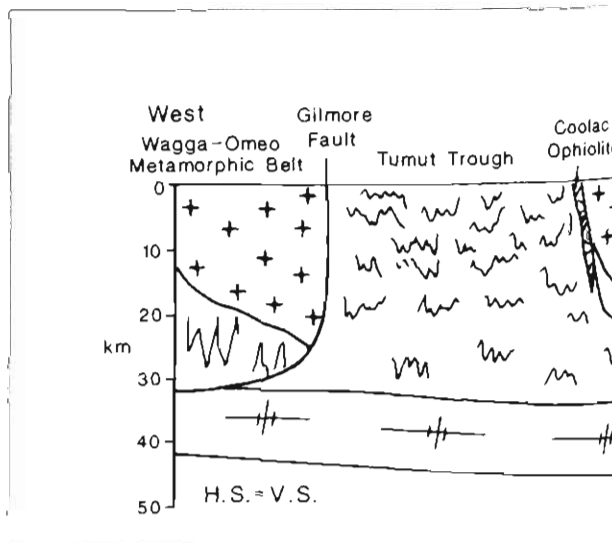
THE Tasmanides Research Group deals with the bedrock that makes up the solid foundation of eastern Australia. These rocks have had a complicated history spanning some 500 million years from about 600 million years to 100 million years ago. In addition, the group has established research projects on rocks with similar ages and geological style to the Tasmanides in Indonesia, Iran and New Zealand. The significance of this work is that it provides an understanding of how eastern Australia developed through time – a history of events. The group is concerned with developing a better understanding of geological history which in turn will provide the conceptual basis for exploration for economic resources (both metalliferous

and energy) which are becoming increasingly more difficult to locate.

The year has been successful for the group, with the initiation of three new PhD projects in 1992 bringing to a total of 11 currently enrolled PhD students and four currently enrolled honours students. Many of them are involved with current projects, and several new projects have been initiated.

An ARC-funded project on the Anakie Inlier, which forms a little-studied region of bedrock in central Queensland, was initiated in 1992. New PhD student Tim Green and Dr Chris Fergusson (Group Co-ordinator) have completed a long stint of field work involving detailed geologic mapping and in particular measurement of structures in metamorphic rocks and mapping the distribution of rock types. This work has

Speculative geological cross-section of the Earth's crust between Bateman's Bay and Tumut. Small crosses signify granites, wiggly lines folded sedimentary and volcanic layers and long crosses lower crust



Dr Chris Fergusson (Group Co-ordinator at left), Dr Paul Carr (middle) and Dr John Pemberton at the entrance to the University's New Science Building

be in a suitable form for publication.

Dr Carr has been preparing and analysing samples of Sydney Basin volcanic rocks for isotopic analysis and has continued to develop strong ties with the Centre for Isotope Studies (CSIRO, North Ryde) which has given the Group access to sophisticated equipment that would otherwise be unobtainable.

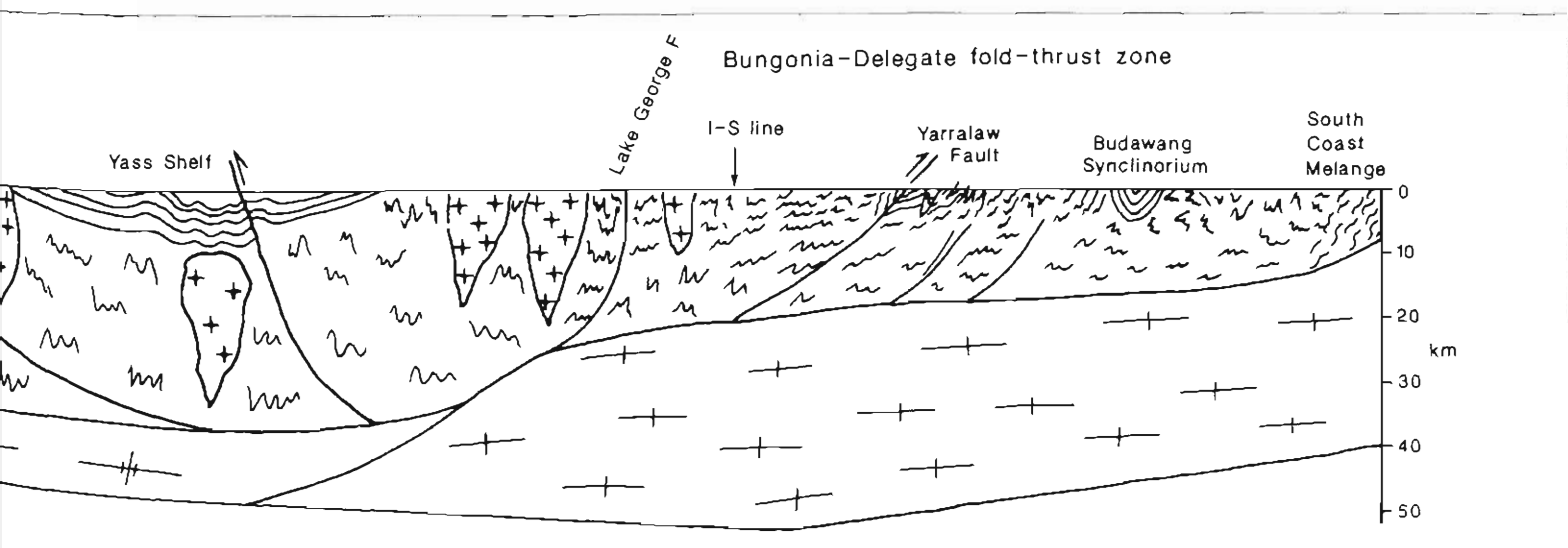
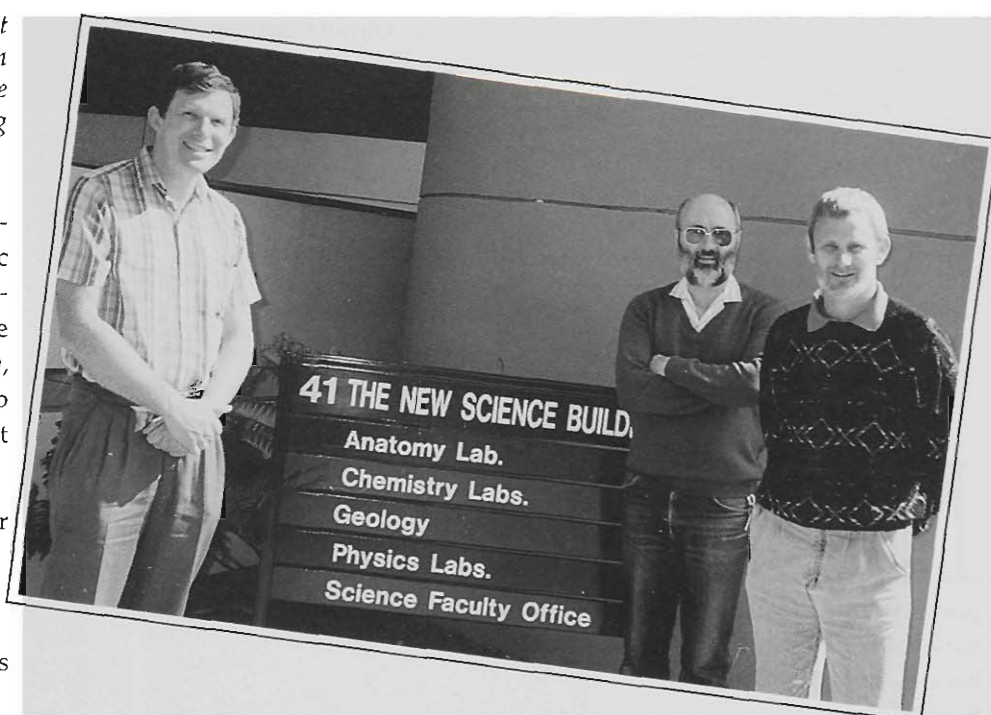
Associate Professor A J Wright, Dr J W Pemberton and G Colquhoun (PhD student) have continued their studies on the evolution of the Capertee High (with at least two papers in preparation).

A collaborative study by Associate Professor B G Jones and other group members on Ordovician contourites should be published in the near future. Studies of Cambro-Ordovician fossils from Mount Patriach, New Zealand, by Associate Professor Wright and Dr R A Cooper (associate member), should be submitted for publication soon, as should detailed studies of the Late Silurian Australasian brachiopod *Notoconchidium* (Associate Professor Wright and Dr M J Garratt, associate member). Three students (Surono, Susilohadi, Yunus) are involved with stratigraphic, sedimentologic and tectonic studies in various parts of Indonesia (Java, Sulawesi) and have enabled

the group to undertake research in regions providing modern analogues for parts of the Tasmanides. Another PhD project (Hamed) is on the Early Palaeozoic stratigraphy and tectonics of Iran. A PhD project (Memarian) was begun in September on an analysis of joints in the Sydney Basin. Another PhD student, Stuart Tye, started a project on the basal Sydney Basin and is being supported by a Tasmanides Research Group scholarship.

Members of the group have been heavily involved in editorial activities over the past two years. Associate Professor Jones continued a major effort as editor of the Australian Journal of Earth Sciences, with editorial assistance from Drs

Carr and Fergusson. This is a significant achievement for the Department and the group and serves to increase the awareness of both in the earth science community. A volume of papers prepared for a conference held in January 1991 on the Lachlan Fold Belt has been edited by C L Fergusson and R A Glen (Geological Survey of New South Wales) and awaiting printing as a special issue of the prestigious Elsevier journal *Tectonophysics*. Dr Carr is editor for the 1991-92 Research Report for the Centre for Isotope Studies, a co-operative venture between CSIRO and several universities with financial assistance from ARC.



ACCOUNTABILITY AND FINANCIAL REPORTING

Co-ordinator: Professor Michael Gaffikin (Department of Accountancy), tel. 21 3718

Members: Mr A Ariyadasa, Mr L Blackett, Mr A Chowdhury, Dr B Cornelius, Ms M Day, Ms M Donnelly, Mr G Gniewosz, Ms M Kaidonis, Associate Professor G Linnegar, Mr R Perrin, Mr R Shannon, Associate Professor G Tibbits, Mr R Williams (all from Accountancy).

It is contended by many of the researchers in the group that the numbers generated by the accounting system cannot be isolated from the political and social context in which they will be used. The numbers obtain meaning from the environmental context in which they will be used. Traditional accounting, and the research that supports it, usually overlooks this. All too often numbers are seen as having some inherent quali-

considerations into the design of accounting systems. These systems can range in size and complexity and should be designed to facilitate intra-organisational external financial reporting. Papers on this theme have been presented at international conferences by Michael Gaffikin and Sudhir Lodh.

One of the areas in which the members of the group have had considerable success is in computer-aided and computer-managed learning. The work undertaken by Kathie Cooper and Vivienne Coomb first attracted attention in Tasmania where they made their first presentations but then attracted a great deal of international attention when they made presentations in Britain, Spain and Canada – in fact, at the British Accounting Conference one of their papers was described as the most significant paper at the conference. The innovations they have introduced into teaching and managing accounting education have been impressive. Research activity has been maintained by several group members as they introduce new technologies and greater intellectual sophistication.

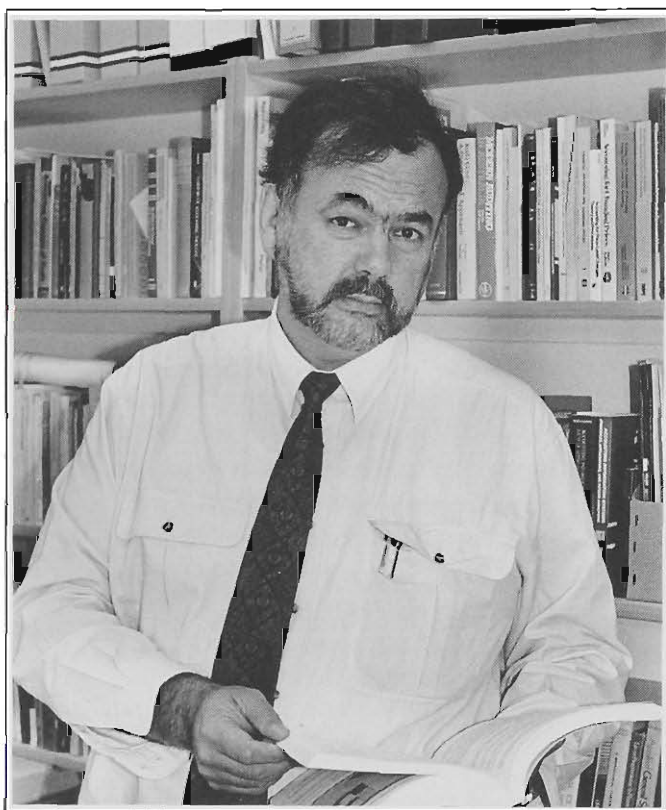
Another area of concentrated research activity has been small business. Several mem-

bers are interested in and concerned with this area so important to the Australian economy. With regard numbers of bankruptcies and liquidations at present this is obviously an area of considerable significance to Australia. Research has ranged from the special accounting and management problems facing small enterprises to the problems of raising and managing venture capital. Several members of the group are pursuing small enterprise research and some new members of the Department with this special research interest have joined the group.

Research continues to be undertaken in

MANY members of this development group have made presentations at major international conferences. Venues have included Britain, Spain, France, Japan, New Zealand, Canada, India and Taiwan. Many of the papers have been revised and submitted for journal and book publication.

Now that fraudulent accounting is listed as a sin in the new Roman Catholic Catechism it is important that the notion of accountability be more fully explicated. The work undertaken by the group continues to investigate the means by which the vagaries and inconsistencies of accepted accounting practices and procedures permit the manipulation and creative exploitation of financial information. Intangible assets have always been a source of concern for perceptive accountants because by their very nature, as their name implies, these so-called assets have often been the subject of spectacular variations in interpretations by the experts (remember the opinions expressed in the 1990 Bond Corporation Financial Statements). Thus, the work carried out by Garry Tibbits and Mary Day is timely – a study of shareholders of a major Australian company to gauge their understanding of the term intangible assets. They have completed this study and continue to pursue avenues of publication for their results.



Co-ordinator, Professor Michael Gaffikin

ties which will be revealed when included in some formal presentation. These magical qualities of numbers appeal to politicians. Numbers as measures are designed to represent some attribute of the objects to which they refer. If accounts indicate a measure of profit then it is important that the idea of profit be fully understood by those relying on those accounts. Thus, to be meaningful to users, to be reliable and relevant, accounting information should be designed to reflect some coherently defined notion of profit that will reflect the users and their decision environment. Several members are pursuing studies that attempt to incorporate such

other areas relevant to the group's aims and objectives. One of these is governmental financial reporting and audit. Warwick Funnell has been on leave in Britain with a view to adding an international dimension to his study. This concerns the use of efficiency audits in governmental institutions. Mary Kaidonis has been on leave also, in Britain and Canada, where she too aspires to add an international understanding to her work in the area of financial information systems design and semi-government institutions. Her work, as

with many other members of the group, is distinctive in its use of the case study method and she has been investigating new means of developing what has been a popular research method.

Other areas actively being researched include inquiries into recent accounting standards, a survey of Australian company financial reporting, the internationalisation of accounting standards across cultural barriers and the influence of developments in EDI on auditing practices. A small group of researchers had been very actively in-

vestigating stock market reactions to accounting (and other) announcements.

There has been a substantial increase in the number of research students in the Department of Accountancy. Many are working on projects with direct relevance and relationship to the group. At this stage many are in the early developmental stage. As these studies develop the research carried out in the group will be further enhanced. This has become increasingly apparent as some students' work has indicated exciting new advances.

Members: Mr J Freestone, Dr G Hampton, Dr R Henry, Dr N Mackay, Dr B Walker (all from Psychology).

GROUP MEMBERS have agreed to a set of objectives to be met in the pursuit of research excellence in this area, which they see as encompassing counselling and health psychology (as well as clinical psychology):

1. To explore the often-ignored conceptual underpinnings of work in this area (Dr Mackay, Dr Henry, Dr Walker and Associate Professor Viney have been analysing psycho-analytic, cognitive-behavioural and constructivist concepts);
2. To devise new methods of assessment for it (Ms Bowen, Ms Gerry and Ms Tooth have been devising better assessment tools for severely developmentally disabled people);
3. To develop and evaluate better interventions in this area (see below);
4. Regular research and Personal Construct Group meetings and special workshops, such as will be run on Qualitative Methods in clinical psychology with researchers from Macquarie University in November; and
5. To liaise with the University Counselling Centre and local Health Services to provide more community-relevant research in this area. A few examples, only, of such liaison-based research are provided.



Co-ordinator of this Development Group, Associate Professor Linda L Viney is to Chair the Steering Committee for the 10th International Personal Construct Congress, to be held in 1993

The group has successfully completed, in liaison with Ms Tineke Robinson, evaluation of the effects of an Illawarra Area Health Service Palliative Care Unit on its patients and staff. The findings, which are now being made available to people, were as follows. Cancer patients in palliative care units, when compared with cancer patients dying without this specialised service, showed its benefits in terms of their better quality of life, less anxiety and greater number of enjoyed interactions with others. Their perceptions of pain management and social support were also of interest. Staff working in palliative care units, when compared with staff in burns and

neonatal care units and with similarly aged staff in their last year of general nurse training, also show better quality of life, less anxiety and enjoyed more interactions with others. Their perceptions of their social supports were also relevant. Study of the usage of the unit in the Illawarra by different cultural groups showed it to be meeting some specific needs of immigrants. On the basis of these findings, some useful recommendations for the policy and planning of palliative care have been made.

The group has also begun a liaison with Dr Greg Hampton, Senior Counsellor of the University. In response to the rising number of University Staff consulting his centre, a survey of sources of stress in NSW universities is being carried out. Given the many organisational changes experienced by academic staff recently, in the project being assessed, stress sources as areas of perceived incongruity (and dissatisfaction), which staff need to make more meaningful for themselves. Areas of satisfaction are also being tapped. This data collection is providing a better understanding of the processes of such change in individuals, as well as to identify individuals who are likely to be at risk of mental health problems. Recommendations for change strategies that help to reduce such negative side effects should flow from this research.

Associate Professor Viney will be the Chair of the Steering Committee for the 10th International Personal Construct Congress to be held in Australia in 1993, and Dr Walker will be its Academic Program Convenor.

Members: Dr E Booth, Mr R Crawford, Ms T Gray and Dr M Wilson (all from Education).

IN ITS first year of operation, the Curriculum Research Group has made significant progress. As a new group, it has focused on building up strengths in educational research which individual members already have, while at the same time consolidating the three interlinking areas of research in curriculum for which the group has been formed: professional development and curriculum change; intercultural perspectives in the curriculum; and international contexts of curriculum and teacher development.

At a local and national level, the Curriculum Group is offering research expertise to investigate and evaluate the implementation of Key Learning Areas in the primary and secondary schools' curricula. Three areas in which the team have developed significant research interests are in Science and Technology for the primary schools, Art Education, particularly in relation to cross-cultural comparisons, and Mathematics. Across-curriculum concerns at the secondary level include Outdoor Education and AIDS education.

Nationally and internationally, the team is involved in projects investigating links between professional development, curriculum innovation, and classroom practice. Continuing research is being carried out on overseas teaching practice. One project is a longitudinal study of teachers as they graduate from the University. A third project focuses on teachers and curriculum change in three Pacific island countries. Australia's educational links with the Asia-Pacific region are being developed through these projects.

Professional development and the curriculum

Substantial developments in the school curriculum in NSW and elsewhere and the recognition of the crucial role of teachers in the implementation of these changes have been the catalyst for the

Professional Development project. Drs Michael Wilson and Ted Booth have been investigating changes in teachers' perceptions of their professional roles both during and after pre-service programs and in relation to in-service activities. An initial theoretical framework was a model of teacher development proposed by Tony Fielding. A questionnaire to test the validity of this model was developed in 1989. A program of administration of the original questionnaires has continued with new and continuing groups of DipEd and BEd students throughout 1989-1992. In addition, some graduates have completed follow-up questionnaires during their first year in the field. Questionnaire data have been subjected to statistical (including cluster) analyses which has shown considerable change in student and teacher views of their professional role both during and after initial pre-service programs.

Results confirm some of the major changes predicted by the Fielding model while other more subtle developments were not anticipated. Papers based on this data have been presented at conferences in Australia (Australian Teacher Education Association conferences in Melbourne, 1991 and Ballina, 1992) and the USA (American Educa-

tion Research Association, San Francisco, 1992).

The data from the questionnaires were then supplemented through semi-structured interviews, in order to gather more qualitative information on the students' perceptions of what influences their professional development. A series of interviews were carried out with students and first-year-out teachers. Interview data have been transcribed and entered into a data base in preparation for further analysis of the types of professional change perceived to have taken place in relation to context and the factors which influence such changes. It is envisaged that the instruments and techniques developed in this work will be of value in investigations of the relationships between teachers' professional activities and curriculum innovations in Australia and the South Pacific.

Overseas teaching practice

Ted Booth and Christine Fox are exploring the extent to which a cross-cultural teaching practice as part of a pre-service teacher education program can enhance beginning teachers' cross-cultural and international perspectives, as well as their professional knowledge and skills. Overseas practicum pro-

From left, Dr Michael Wilson, Christine Fox (Co-ordinator) and Dr Ted Booth are clearly delighted with Booth's recent publication on Fiji





Tonia Gray has published a number of teaching journals for Years 7 to 10 in health education

grams of one month have been regularly held in Malaysia and Fiji and more recently in Thailand and China. The current study has pre- and post-surveyed all the 1992 participating students' perceptions of cultural and educational factors in their host countries. These surveys, together with post-practice interviews, have been analysed to ascertain the extent to which students' experience has enhanced their professional knowledge and skills. The data from this project clearly support the educational benefits of the overseas teacher practicum.

Comparative analysis of curriculum innovation processes

Research by Christine Fox, with Ted Booth and Michael Wilson, has been started on curriculum innovation and the professional development of teachers in Western Samoa, Fiji and Vanuatu. The project got under way in mid-1992 with a preliminary visit by Christine Fox to Fiji and Western Samoa. She is also having discussions with a co-researcher in Vanuatu. The initiation of this research was made possible with additional research funding from the Fac-

ulty of Education and the Graduate School of Education.

Teachers in the Pacific are, like their counterparts in Australia, coping with the results of rapid social and technological change as reflected in large-scale changes in educational policy and curriculum innovation. In the Pacific, particularly where new resources have been supplied to schools, teachers do not always feel they have sufficient training to deal effectively with these materials or with other requirements for curriculum change. One focus of the research project is to investigate the impact of in-service programs for teachers. Christine Fox has for the past few years been researching the role of consultants in educational development assistance projects, and has been developing a new theory of professional intercultural communication as an outcome of her research (PhD submitted to Sydney University 1992). A paper outlining this theory was presented at the AERA San Francisco Meeting in April 1992, and was the subject of a book chapter in two other publications.

Discussions are under way between Michael Wilson and representatives of

the University of Papua New Guinea for research and teaching exchanges between UPNG and the University of Wollongong. If these preliminary discussions result in funding of research and professional development projects, the team will be heavily involved in 1993 and beyond.

Key learning areas and the school curriculum

Research by Tonia Gray on the impact of Extended Outdoor Educational Programs on adolescents is going ahead. She is also continuing research into evaluating the effectiveness of AIDS Education Programs in various educational settings. Her work in AIDS education has resulted in a number of publications and it is anticipated that her research will attract substantial funding in 1993. Ms Gray was a contributing author for a Year 7-10 Textbook on Health Education and has been commissioned for future authorships in 1993. This work will also provide substance for Gray's doctoral research.

Ian Brown and Brian Ferry have explored professional development in curriculum areas of art and science respectively. Ian Brown has analysed cross-cultural differences in children's drawing development in Thailand and Australia. He has found substantial differences, not only in relation to aspects of the drawings themselves, but particularly in the teaching approaches to art in both countries.

A conference paper was presented at the national conference of art educators in Hobart in July 1992, and an edited version of the paper will appear in the *Visual Arts Research Journal*. Brian Ferry's research in primary science has concentrated on teacher needs for implementing the new K-6 Science Curriculum in NSW schools. His research in 1992 has involved extensive surveying and interviewing of teachers in the region. Conference papers have been presented at NSW and national science conferences, and will be delivered at AARE conference at Deakin in November 1992.

IN 1991-92 the Centre for Multicultural Studies (CMS) carried out wide-ranging research, much of it commissioned by government agencies. Projects covered issues as varied as immigration and industrial restructuring, language services, refugees in the labour market, and drug and alcohol services.

The Centre moved into two new areas. The first was that of training for a culturally diverse workforce. The initiative of Mary Kalantzis and Bill Cope led to the establishment of a Centre for Workplace Communication and Culture, co-sponsored by CMS, the Faculty of Education at the University of Technology Sydney and the National Languages and Literacy Institute of Australia. The other new area was publishing: together with the Office of Multicultural Affairs (OMA) the CMS brought out a series of Working Papers on Multiculturalism. Most of the 22 papers (generally of book length) are based on research commissioned by OMA. The series looks set to become an important resource for people working in the multicultural area – community workers, academics and public servants.

However, policy-orientated consultancy remains only one part of our research effort. Independent work on migration, ethnic diversity and the development of multicultural societies is central to the Centre's objectives. CMS staff continued to publish in academic journals and to participate in national and international conferences, as documented in the section on publications below. Visitors and research fellows from overseas also help to enrich our work.

Selected Research Projects July 1991 to the end of 1992

Client Database for Migrant Welfare Workers

Funding: \$50,000

Centre Staff: David Tait, Graham Harrison

Analysis of Ethnicity Related Data from the 1986 Census

Funding: \$29,000 from the Commonwealth States Research Program

Research Team: Graham Harrison, Stephen Castles

Non-English Speaking Background Parent Participation Project

Funding: Stage 1: \$28,000; Stage 2: \$80,000

Research Team: Mary Kalantzis, Bill Cope, Robyn Gurney

Drug and Alcohol Intervention in a Multi-ethnic Society

Funding: \$106,000 from the Commonwealth Department of Health and Community Services (Research into Drug Abuse Committee)

Research Team: Michael Morrissey, Caroline Alcorso, Colleen Mitchell, Jodie Brooks, Larry Stillson and Carole Medcalf

Euroaustralians: The Contribution of Italians to Australian Society

Funding: \$120 000 from the Fondazione Giovanni Agnelli, Turin

Research and Editorial Team: Stephen Castles, Caroline Alcorso, Ellie Vasta (Sociology), Gaetano Rando (Languages), Cesare Popoli, Maureen Dibden and Colleen Mitchell.

Immigration and Industry Restructuring in the Illawarra

Funding: \$55,000 from the Bureau of Immigration Research

Research Team: Michael Morrissey, Maureen Dibden and Colleen Mitchell (with Robert Castle, Ray Markey and David Bourne)

Refugees in the Australian Labour Market

Funding: \$45,735 from the Bureau of Immigration Research

Research Team: Robyn Iredale, Ian Watson (Centre for Work and Labour Market Studies), Bob D'Arcy of Perry, D'Arcy and Associates, Anne Rutherford, Shahnaz Naughton

Review of the National Accreditation Authority for Interpreters and Translators (NAATI)

Funding: \$49,980

Research Team: Robyn Iredale and Peter Eyles of EMD Consultants

Submissions by Non-English Speaking Background Individuals and Groups to Public Enquiries and Ministerial Consultations 1982-1991

Funding: \$11,750 from the Office of Multicultural Affairs

Research Team: Robyn Iredale, Adrienne Millbank

Taking Few Chances: The Employment of Overseas Trained Professionals and Technicians in Australia

Funding: \$32,000

Research Team: Robyn Iredale, Pauline Newell, Colleen Mitchell

Serial Sponsorship - Analysis and Development of Options

Funding: \$29,947 from the Department of Immigration, Local Government and Ethnic Affairs

Research Team: Robyn Iredale, Stephen Castles, Jane Innes, Adrienne Millbank, Shahnaz Naughton

Access to Excellence - Review of Issues Affecting Artists and Arts from Non-English Speaking Back- grounds

Funding: \$103,720 from the Office of Multicultural Affairs

Research Team: Eugenia Hill, Multicultural Artworkers Committee, Adelaide; Nicholas Tsoutas, Institute of Modern Art, Brisbane; Sneja Gunew and Nicos Papastergiadis, Deakin University. Coordination: Mary Kalantzis and Stephen Castles

Evaluation of the Community Relations Strategy

Funding: Office of Multicultural Affairs: \$60,000, Office of Local Government: \$30,000

Research Team: Michael Morrissey, Stephen Castles, Colleen Mitchell

THE CENTRE for Research Policy (CRP) is a Special Research Centre or 'centre of excellence' of the Australian Research Council. CRP conducts an active research, consultancy and education program, nationally and internationally - with a particular focus on Asia. The Centre operates as a small high-quality, multi-skilled team of approximately 12 people.

Its objective is to take a national leadership role in providing the expert research and advice that is necessary to support the global competitiveness of Australia's research and innovation enterprise.

It places a high priority on maximising the impact of its influence on research policy analysis - through providing foresight of imminent key policy issues, through education of present and future research policy makers, through promoting collaboration and networking nationally and internationally, and through direct involvement in shaping the research policy process.

Research is aimed at deepening the international theory and understanding of research and research policy processes, while relating research to practical policy needs. Activities therefore have both short-term and long-term outcomes, and fill gaps in empirical information while developing a coherent theoretical agenda for the Centre. The initial focus of activities is on public-sector research and its application.

The activities of CRP are organised into four program areas:

- Program 1: *Research Culture, Organisation and Management*

Comparative studies of the evolution of 'new' research cultures; market/knowledge interaction in mature research organisations; cultural frameworks for public - private sector research relations; 'centres' within Australia's university system; leadership, management for innovative organisation.

- Program 2: *Policy - Research Linkages*

Research steering impacts of alternative funding mechanisms; policy - or-

ganisation interactions; direct funding - infrastructure balance.

- Program 3: *Research - Application Linkages*

Identification of public - private sector research strengths; commercialisation of public sector research; Australia's Cooperative Research Centres program.

- Program 4: *International Research and Technology Policy*

Working through linkage via international networks, collaborative research on public sector research; commercialisation; globalisation and national research strategies; comparative S&T policy frameworks and mechanisms.

The Centre also plays a key role in regional science and technology policy activities throughout Asia. CRP is:

- Regional Centre for STEPAN, the UNESCO-linked 'Science and Technology Policy Asian Network' - directing a cooperative international development program on S&T policy, management and information systems.

- International Coordinating Institution of the Asian Pacific Economic Cooperation forum Human Resource Program on Industrial Technology (APEC-HURDIT).

- Adviser and participant in Australia's bilateral and multilateral S&T relationships with Asian countries.

Science and Technology Policy Asian Network (STEPAN)

Present member countries of STEPAN are: Afghanistan, Australia, Bangladesh, People's Republic of China, India, Indonesia, Republic of Korea, Lao People's Democratic Republic, Malaysia, Maldives, Nepal, New Zealand, Pakistan, Philippines, Sri Lanka, Thailand and Vietnam.

STEPAN is an official Asia-wide network of people and institutions involved in research and training support for national science and technology (S&T) policy and management. The organisation's program is devoted to the development of support programs to assist the development of S&T management

information systems, to foster the linking of research with social and economic application, and to promote human resource development.

STEPAN operates under the auspices of UNESCO through 'National Focal Points'. These are national institutions related to S&T policy that have been formally designated by participating governments. National Focal Points act both as referral points for regional network activities and as coordinators at a national level for linking S&T policy making and management with active S&T policy research and training interests. Overall management of STEPAN is the responsibility of the Centre for Research Policy, which, in consultation with National Focal Points and UNESCO, develops STEPAN activities, coordinates with relevant international agencies, and on behalf of member countries, seeks funding for program support.

The Asia Pacific Economic Cooperation Network for Human Resource Development in Industrial Technology (APEC-HURDIT)

Present member countries of APEC are: Australia, Brunei, Canada, Chinese Taipei, Hong Kong, Indonesia, Japan, Korea, Malaysia, New Zealand, People's Republic of China, Philippines, Singapore, Thailand, and the United States of America.

A ministerial meeting in November 1989 decided that the idea of a Pacific Organisation for Economic Co-ordination and Development (OECD) was premature, but that a dialogue should begin on regional and global trade and economic issues, backed up by a program of work. The new initiative was termed the Asia Pacific Economic Cooperation (APEC) forum.

The HURDIT Network

Members of the HURDIT network are Lead Institutions (concerned with HRD in industrial technology) nominated by the governments of the 15 member countries of APEC. Australia has been nominated by APEC to coordinate the network, and in turn Australia nominated the Centre for Research Policy to act as Coordinating Institution.

THE KEY CENTRE for Mines' (KCM) objective is the provision of education, research and consulting services for the minerals industry. The Centre is a joint initiative between the University of New South Wales School of Mines and the University of Wollongong Department of Geology and the Department of Civil and Mining Engineering. It promotes, markets and develops training and research activities in the areas of applied geology, mining engineering, mineral processing, mineral extraction and computer applications for the mineral industry in response to the needs of professionals who are often located in remote areas.

The Centre offers part-time postgraduate programs, leading to the Graduate Diploma in Mining Management, Master of Mining Management and Master of Applied Science in Geological Data Processing. They are structured to cater for the needs of the mining industry and for those in remote areas, programs comprising intensive residential short courses complemented by assignments and special projects. There are 56 post graduate students enrolled in the KCM programs in both institutions (Universities of NSW and Wollongong). Graduates are awarded a Joint Degree from both Universities.

In 1991-92, the Wollongong Division of KCM was engaged in providing active support to the KCM, Kensington Division, particularly in offering short courses. In addition it carried out joint research work in the geology and mining fields. The area of research which attracted substantial funding was dust control in mines. Other areas of research include the application of geostatistics to mine planning, the application of rock bolting to strata enforcement in soft formation, ventilation of long headings in underground coal mines, mine water, mine gas drainage and outburst control, influence of coal geology on gas content of coal, geology of coal measure sequences, research on tasmanides,

invertebrate fossils, biostratigraphy of the early and middle palaeozoic, and development of computer-based statistical exploration program for coal deposits. The research activities of the academic members of the Key Centre for Mines has been extensive, as shown in the publication pages elsewhere in this report.

To encourage and foster collaborative research between the Key Centre members, in 1991 the Key Centre made \$30,000 available as seed funding to support joint research work for five projects. This fostered collaboration between the Wollongong and Kensington Key Centre staff, and a successful submission was subsequently made to the National Energy Research Development & Demonstration Program for joint research on the Application of Electrostatic Enhancement of Water Particles for Dust Suppression in Mines involving researchers from the University of NSW School of Mines, the Commonwealth Scientific & Industrial Research Organisation (CSIRO) of Lucas Heights and the University of Wollongong.

Plans are under way for the Key Centre to support three research projects leading to PhD studies beginning in 1993. Two of these projects, mine gases and geostatistical studies, will be undertaken at Wollongong. The third, on ground water and environment, will be carried out at Kensington with active research involvement by academics from Wollongong.

The Key Centre has also maintained an international arm which is involved in the development of curricula and in teaching of specialist courses in Asia, the Pacific and the Middle East.

A number of seminars and conferences have been organised by the Key Centre for Mines, the most recent the 11th International Conference on Ground Control in Mining, which attracted delegates from 14 countries. The keynote address was delivered by the USA Assistant Secretary for Labour.

Department of History and Politics

Dr Anthony Ashbolt
tel. 21 3703

DR ASHBOLT engaged in research in a number of areas. First, he collected additional material from US underground newspapers in the 1960s in order to revise sections of his manuscript on the Sixties in the San Francisco Bay Area. The script is now with Temple University Press. He also reviewed the film *Berkeley in the Sixties* and reviewed a book on Berkeley for the *Australasian Journal of American Studies*.

He continued research in the area of modernity and postmodernity. He was asked by Jill Kitson (Radio National) to review one of the books central to contemporary debate progress and modernity – Christopher Lasch's *The True and Only Heaven* – and the review was broadcast on May 21. He also began researching the campaign against 'Political Correctness' being waged in the American media. That led to a conference paper – 'Postmodernity, Political Correctness and the Collapse of Ideology' – delivered at the Australian New Zealand American Studies Association conference at Flinders University.

Ashbolt also worked on and finalised an article which has been an interest of his for several years: 'Prodigal Sons and Political Amnesia: Jewish Identity, American Radicalism, Israel', *Australasian Journal of American Studies*, July 1992. It details and analyses the way in which many American Jewish radicals who rediscover their Jewish identity move towards the right of the political spectrum. Increasingly, a concern for the state of Israel dilutes and ultimately (in the main) dissipates their radicalism. He plans on this paper being part of a larger project on radicalism in the USA which might also develop into a comparative analysis (using Australian material). He carried out further research into the topic of state aid to private schools and hopes to use that material as part of a larger project dealing with the relationship between the public and private domains (or the state and civil society).

Department of Philosophy

Dr Harry Beran
tel. 21 3712

DR HARRY BERAN is writing a book which develops a democratic theory of political self-determination. The theory is intended to assist in the peaceful and just resolution of disputes over political borders. In 1991, a chapter from the book was published in Estonia in Russian translation. Dr Beran has also compiled an anthology of contemporary philosophical writings on secession and political self-determination.

Department of Psychology

Dr David Brown
tel. 21 3651

THE INDUSTRIAL and Organisation Psychology Unit, based within the Department of Psychology, concentrated on developing the industry/University relationship established in previous years. Principle consultants Dr David Brown and Dr Peter Smith were engaged in a number of major projects involving the NSW Water Board, BHP and The Meat Marketing Board. These projects covered award restructuring, the development and evaluation of performance indicators in industry, the measurement of performance in response to 12-hour and eight-hour shiftworking, and management selection in Australia.

Conference papers by members of the Unit were delivered at the British Psychology Society Occupational Psychology Conference, UK, 1991, Australian Centre for Industrial Relations Research and Training, Sydney, 1991, International Relations Research and Training, Sydney, 1991, International Commission on Occupational Health 10th International Symposium on Night and Shift Work UK, 1991, First Asian South Pacific Association of Sports Psychology International Congress, Melbourne, 1991, British Psychology Society Occupational Psychology Conference, UK, 1991.

The Industry/University relationship de-

veloped by the Unit led to the establishment of two APRA Industry awards, and one University-Water Board APRA equivalent award. The unit now has four full-time PhD candidates. Its specialisation in research concerning award restructuring, and the development of performance indicators in industry was acknowledged by an invitation to Dr Brown to convene a symposium at the British Psychological Society Occupational Psychology Conference, in Brighton (UK) in 1993. Entitled 'From vision to practice: some examples of Industrial Psychology at work in Australia', the symposium focuses on research presently being conducted in the unit. Along with Dr Peter Smith, four of the unit's Postgraduates have been invited to present papers at this symposium.

Department of Philosophy

Dr John Burgess
tel. 21 4069

DR JOHN BURGESS has papers forthcoming on the alleged connection between voluntary euthanasia and the Nazi notion of ethnic cleansing; fetal status and the ethics of fetal-tissue therapy; the respective roles of model theory and truth theory in formal semantics; G E Moore on common sense and the external world.

A co-authored paper locating the beginnings of sentience in the human fetus is complete and looking for a home. He is co-editing a book on the scientific, ethical and legal issues raised by fetal-tissue therapy to which he will be contributing six chapters as author or co-author.

Dr Burgess is currently completing several papers on slippery-slope problems in bioethics, a paper on moral realism, and another on speech-act theory and conversational analysis.

Department of Modern Languages

**Associate Professor
Vincent Cincotta**
tel. 21 3635

THERE ARE currently two projects being worked on in terms of research/publication. The first – and the more important in terms of immediacy – is the completion of the first-year Italian language program for software computer-based learning. At present, approximately half the course is on disc: it is hoped that by February 1993 the remaining half will be completed.

The second project is a long-term cumulative one, which is nearing the stage of a first draft manuscript. It is the only English-language compilation of the history of the Spanish musical theatre and its major exponents from its inception in the mid-17th century to the present. It is hoped that the manuscript will be ready for publication by the end of 1994.

Department of Sociology

Dr Phillip D'Alton
tel. 21 3613

DR D'ALTON completed research on western martial arts with D C Peterson for an article published in China in August 1991. He is now carrying out textual research and collecting visual material for a book on the Shaolin Buddhist Temple in China with the working title *Seeds of the Tree*.

Information Technology and Communication Unit

Mr Tony Dean
tel. 21 4142

TONY DEAN is a relative newcomer to the Information Technology and Communication Unit. His current research interests are focused on the use of information, telecommunication and

broadcasting technology for educational purposes.

Tony is currently supported by funding from the Faculty of Informatics and by a Vice-Chancellor's Challenge Grant, to pursue research into the innovative use of video conference technology as it applied to distance education.

The research is an extension of his previous endeavours which results in the first Australian (and possibly global) transmission of video conference signal over broadcast television.

Department of Philosophy

Ms Susan Dodds
tel. 21 3621

SUSAN DODDS is primarily engaged in research on the connections among political philosophy, philosophy of law, feminism and ethics. She is working on a book in which moral arguments for property rights in the liberal tradition are critically assessed and is preparing a paper on feminist critiques of liberalism.

Department of Philosophy

Dr Robert Dunn
tel. 21 3615

DR ROBERT DUNN'S chief area of research is philosophical psychology, including moral psychology. He is working on a manuscript entitled *Attitudes and Agency*, which focuses on issues connected with irrational propositional attitudes, beliefs, desires and intentions. The manuscript is intended to complement his published book on irrational action, *The Possibility of Weakness of Will*.

Department of English

Dr Richard Harland
tel. 21 3678

THROUGH 1991-1992, Richard Harland has been finishing work on *Beyond Superstructuralism: The Syntagmatic Side of Language*. The book is now in production and will be appearing under the Routledge imprint early in 1993.

The remaining chapters as originally planned were completed in 1991: chapters on literature, and on Structuralist and Poststructuralist techniques of textual interpretation. In relation to literature, syntagmatic theory is shown to open up new angles of understanding on the language of poetry, and to challenge several established shibboleths of 20th century literary criticism. In relation to textual interpretation, Harland argues that binary polarisation technique and deconstruction are more closely allied than is commonly recognised and that both depend upon certain hidden moves of extraction and abstraction. These moves are capable of producing general overarching categories from any evidence whatsoever; and binary relations, or relations of Derridan *difference*, then follow automatically.

Whereas Harland's previous book, *Superstructuralism*, presented the Structuralist/Poststructuralist vision in an essentially favourable light, this account of the practical techniques used by Structuralists and Poststructuralists is almost entirely hostile.

In 1992, following suggestions from the publisher's reader, new chapters were included on the 'natural grammar' movement, taking in such linguists as Givón, Heine, Bybee, Closs-Traugott, Hopper and Thompson. This anti-Chomskyan movement proved to be in many respects compatible with the syntagmatic way of thinking and led to several profitable extensions of the theory. At the same time, the chapters of Chomskyan linguistics were revised, with a sharpening of the distinction between 'grammar' and 'syntax' and a re-focusing of the relation between syntagmatic theory and deep structures/D-structures.

Since finishing *Beyond Superstructuralism*, Harland has turned to the literary applications of syntagmatic theory. The sequel to *Beyond Superstructuralism*, as already announced in the pages of that book, will further explore the workings of language in poetry. As a general principle, Harland claims that there is no one way of using language that is characteristic of all poetry: different poets in different periods stretch and bend the possibilities of language in quite contrary directions. A syntagmatic approach proclaims no single master-key to the study of style in poetry; but by extending our understanding of language, it helps to reveal at least some of the various directions which poets have followed – directions which have remained largely *unthinkable* under the terms of New Criticism and the Poststructuralist approach.

Department of Modern Languages

Dr Daniel Hawley
tel. 21 3719

DR D S HAWLEY has been investigating Indianism in 18th century France. The study focuses on the information then disseminated in France in the 18th century on Indian civilisation, philosophy and religion and its impact on certain of the *philosophes*.

School of Creative Arts

Mr Christian Heim
tel. 21 4098

THE BULK of Christian Heim's research – he is a composer in the School of Creative Arts – is the writing of music; some conducting work has been undertaken as well.

Most of his research time went into the writing and producing of the Art Musical 'Starlight' which premiered in the Hope Theatre on August 8. This two and a half hour work combines music, acting, singing, poetry, reciting, dance and visual art

in the forms of sculpture, photography and design. Heim wrote the music, songs, poetry, libretto and outlined the design concepts as well as directing the actors. He was also responsible for the conducting and rehearsing.

The music was scored for an instrumental ensemble of ten, a mezzo-soprano, a bass voice and a female chorus of ten. It aimed to combine popularist and more avant-garde styles.

'Starlight', on a conceptual level, explored the interrelationships among the various art forms. Most of these art forms are represented within the School of Creative Arts, so that Heim found himself exploring some of the philosophies basic to the workings of the School. 'Starlight', its performance and the investigation into these interrelationships among art forms were offered as an Interdisciplinary Project subject in Spring Session 1992 with 22 students taking part.

Department of Modern Languages

Dr Gary Ianziti
tel. 21 3614

DR GARY IANZITI has returned from the University of Trieste, Italy, where he spent three years teaching The History and Theory of History-writing in the doctoral program, Faculty of Arts. While abroad he was involved in several collective research projects, including one on Printing and Propaganda in Early Modern Europe, and another on The Great Families of Italy. The results of the latter project are about to appear in the German volume, *Die grossen Familien Italiens*, herausgegeben von Volker Reinhardt (Stuttgart: Alfred Kroener Verlag, 1992).

In Italy, Dr Ianziti was also able to carry out and complete research into the methods, techniques, and aims of history-writing in Renaissance Italy. This is a continuing project, whose initial stages were funded by a grant from the Australian Research Council (ARC). One outcome

is expected to be the publication of a book, tentatively titled *The Invention of Glory: Writing History in Renaissance Italy*, commissioned by Oxford University Press. The intention is to pick up the story where Dr Ianziti's previous book (OUP, 1988) left off. Rather than focus – as most scholarship has done – on the historiographical production of a single Italian centre, the new book will attempt to offer a synthesis which ranges over the whole peninsula. A critical perspective which supersedes the usual recourse to obstructions will be established. If the Renaissance marked a turning point in the ways of conceiving and representing history, this process is not definable as a sudden leap into modernity. Rather it is inscribed within codes of historiographical practice which still need to be described and catalogued. Innovation is not a transcendental value in itself; it must be understood within a context which includes an assessment of professional commitment, readership expectations, and pressures of a political nature.

Department of Modern Languages

Mr Henri Jeanjean
tel. 21 3643

Minorities in the European Communities (EC) with particular reference to Occitania.

THROUGHOUT Western European history, the formation of Nation-States has been dictated by wars and annexations and not by the interests of the peoples of Europe. This resulted in struggles of ethnic groups for recognition which continue today.

This research analyses such movements in the EC with particular reference to the Occitan movement.

Department of History and Politics

Associate Professor

Colm Kiernan

tel. 21 3706

ASSOCIATE PROFESSOR Kiernan's research is on Home Rule for Ireland and the Formation of the Australian Labor Party, 1883 to 1891. This has given rise so far to *The Irish in the Labor Movement*, New South Wales Parliament Press, Sydney, 1991 and to 'Home Rule for Ireland and the Formation of the Australian Labor Party, 1883 to 1891', *Australian Journal of Politics and History*, Vol. 38, 1992, No. 1, pp 1-11. It is part of a larger study of the Irish contribution to Australian politics.

This research has reached a crucial stage where he is striving to establish that the branches of the Labor Electoral League, which was the political arm of the Australian Labor Party, was essentially the electoral machine established from 1883 onwards by the Irish National League. Little attention was paid to the connection then, when the emergence of the Australian Labor Party was not expected, or later, when historians looked in other directions. Consequently, he is having to do empirical research that should already have been done. Suffice it to propose that there are good reasons for thinking that the association between the Labor Electoral League and the Irish National League was at least very close.

At the same time Kiernan is writing a book on French history: 'Enlightenment and Revolution in France from 1750 onwards'. This is to advance in time beyond his first two books, *Science and the Enlightenment in Eighteenth-Century France*, Geneva, 1968 and *The Enlightenment and Science in Eighteenth-Century France*, Oxford, 1973, which run on to 1789, to continue the argument up to 1992 or later. He hopes to undertake much of the necessary research and writing while on study leave in the second half of 1993 in the University of Cambridge. His lecture notes and reading generally will provide the basic argument and framework for the book.

There is also an article pending on 'Daniel Mannix and the Communist Party

Dissolution Bill' for a book of conference proceedings to be published in 1993 by the Dr H V Evatt Foundation on 'The Communist Party Dissolution Act: Lessons for Constitutional Reform'.

Department of Mathematics

Dr Philip Laird

tel. 21 3421

A LAND Freight Transport Energy Evaluation conducted by Dr Laird and sponsored by the Energy Research and Development Corporation is continuing within the Department of Mathematics. Most work so far has been on the Sydney-Melbourne corridor, and now NSW coal exports and other transport corridors such as Sydney - Brisbane are under examination.

Dr Laird has found that with continued upgrading of the Hume Highway, and with improvements in truck technology, there has been significant gains in road freight energy efficiency. On the rail side, the gains have been limited by 'steam age' track alignment. However, if the ruling gradients and limiting curvature on the Sydney-Albury line were improved to Fast Freight Train (FFT) standards, there would be significant gains in rail efficiency and competitiveness. This, coupled with rail increasing its modal share of land freight to 50 per cent, would give by 1999 savings of 40 million litres of diesel fuel a year. Upgrading to FFT standards would also assist in any use of fast 'tilt trains' for passengers.

The fuel saving calculations from easier grades and curves are detailed, and so far have used the M-Train package initially developed by the rail systems. Easier ruling gradients allows a locomotive to haul a heavier load, giving fuel savings for each tonne of freight moved. Reduction in track curvature allows for higher speeds, with savings in fuel being made when heavy trains do not need to slow down before a tight curve, and accelerate after the curve to regain speed. The fuel efficiency of rail freight over well-aligned track such as

Adelaide-Perth is approximately twice that of the Sydney-Melbourne rail link with its present alignment. This factor also shows up in operational costs where in the late 1980s Adelaide-Perth unit rail freight costs were about one half of Sydney-Melbourne unit costs.

Work on the project has been reported in two Industry Commission reports; one on Rail Transport and the other on Costs and Benefits of Reducing Greenhouse Gases. The project is timely, given the increased interest in rail transport with the formation of the National Rail Corporation in 1991 and the Federal Government's 'One Nation' rail upgrading package.

Department of History

Co-ordinator: Mr Henry Lee

tel. 21 3619

ON 20 SEPTEMBER 1992, Oxford University Press published *The Mount Kembla Disaster*, a book of some 300 plus pages, which I wrote with Dr Stuart Pigginn of Macquarie University. The book examines the impact of the Mt Kembla mine disaster of 1902 on the local community, as well as the response of the miners' unions, the coal companies and the government to the disaster.

I am currently writing the last chapter of my PhD thesis on the development of the Wollongong district coal trade in the second half of the 19th Century. This work will be completed and submitted for examination in December.

I am continuing work, with Dr Glenn Mitchell of this Department, on the life and politics of R F X Connor, Minister for Minerals and Energy in the Whitlam Government.

Graduate School of Journalism

Professor Clem Lloyd

tel. 21 3190

WITH THE assistance of an ARC small grant, Professor Clem Lloyd prepared a module on public perceptions of media ethics and standards for incorporation in the 1992 National Social Science Survey which entered the field in late October. With the further help of a University grant, Professor Lloyd continued work on the history of the Australian media. In particular, the grant enabled the collection of material from the Mitchell Library, Sydney, the State Library of Western Australia and the Australian National Library, Canberra.

Professor Lloyd also continued work on a project designed to analyse concepts of press and media freedoms. He completed work on several publications which will appear in 1992-93. These include entries on R F X Connor and Percy Clarey for the Australian Dictionary of Biography, a substantial section of a monograph sponsored by the Public Sector Program, University of New South Wales, on reform of the Australian water industry, published by Pluto Press in November 1992, and a history of the Australian repatriation system (to be published in late 1993).

He contributed a chapter on Australian Prime Ministers and the media to a monograph on Australian Prime Ministers edited by Professor Pat Weller of Griffith University, published in London in December 1992, and a chapter on the Whitlam Government's defence policy to an edited collection on the *Whitlam Government Revisited*, also published in December 1992. He began work on an analysis of the Liberal Party of Australia for inclusion in the next edition of *Government, Power and Politics*, a standard political science text for tertiary students.

Information Technology and Communication Unit

Ms Una Mansfield

tel. 21 4142

UNA MANSFIELD'S current research focuses on the changing relationships among the four main sectors of a broadly construed information industry (telecommunications, computing, broadcasting and publishing), with a special interest in the effects of the changes on the market share of each sector for hybrid and value-added products. The rationale for the research was set out in a paper co-authored with Richard A Joseph and entitled 'Restructuring of the Global Information Industry and the Resulting Demand for New Skills', presented at the 14th Annual Pacific Telecommunications Conference in January 1992 (see Publications elsewhere in this report).

Supported by a one-year grant from the Australian & Overseas Telecommunications Corporation (AOTC) Fund for Social and Policy Research for a project entitled 'Identification of New Roles for Telecommunications Organisations Within the Broader Information Industry', Ms Mansfield has developed a new model of the industry and validated it by reference to selected information organisations in a range of Australian cities.

The model details the well-established convergence of telecommunications with computing, as well as the more recent linkage of the third technology-based sector - broadcasting - with the other two as a consequence of digitisation. Of special interest is the model's treatment of the 'non-technical' elements of broadcasting and publishing and the influence these are having on the three technology-based sectors, as value-added products and services increasingly demand attention to the substance of the information carried. The situation of telecommunications carriers seeking to move beyond pure 'bit transport' into new information services is highlighted.

A second aim of the project was the collection of data on current broad market share for selected products and services, and the development of a method that

uses the model as a basis for monitoring future market trends. A report on this aspect of the study was accepted for presentation at the 15th Annual Pacific Telecommunications Conference in January 1993. Co-authored with Gatot Mardianto, it is entitled 'Monitoring Shifts in Market Share Among Information Industry Sectors'.

Department of Modern Languages

Associate Professor

Brian McCarthy

tel. 21 3720

ASSOCIATE Professor McCarthy, in conjunction with Ray Stace from the Centre for Staff Development, is designing a range of computer-assisted teaching materials for beginner students of French. The template developed for French has subsequently been used as a base for the production of similar materials for Italian, Japanese, German and Spanish. Further support for this project was provided by a Department of Employment, Education & Training (DEET) National Priority (Reserve) Fund Grant of \$24,000, plus three days per week programming support. Brian McCarthy has lectured on this subject and established links with colleagues at institutions in France, the UK and North America.

Department of History and Politics

Dr Ian McLaine

tel. 21 3670

IN THE past year Ian McLaine managed to write only one further chapter of his book, *A War By Any Other Name: Britain, America and the Korean War*. He is however satisfied with the quality and importance of the project - even if frustrated and increasingly ashamed at the time it is taking. The manuscript has reached 100,000 words most of which were read by John Iremonger, now Head

of Melbourne University Press, who said in 1990 that McLaine's 'detailed analysis which brings into play all the elements of diplomatic, economic and political history... sets it apart from books published to date on the subject'. He is encouraged also by the fact that his first book, *Ministry of Morale*, continues to be cited internationally in monographs and journal articles.

Although due for study leave since mid-1991, he has postponed an application in the hope of finishing his study. Now, however, he says he is minded to apply in order both to finish the book and to embark on another – an examination of Britain's part in the Cuban missile crisis of 1962. In particular, he is interested to test the claim that Harold MacMillan, and the British Government generally, exerted considerable influence on President Kennedy during the crisis. The Foreign Office, Cabinet and other documents relating to the affair will be released in 1993 by the Public Record Office in London, by which time he will have completed his reading of the published literature.

Department of History and Politics

Co-ordinator
Dr Glenn Mitchell
tel. 21 3704

Building Work – A History of Industrial Relations in the Australian Construction & Building Industry, 1902-1992.

WORK continued on this project, supplemented by a grant of \$5000 from the Labour History Group in April 1992. The final draft of the manuscript will be submitted 12 noon, 29 January 1993.

Department of Sociology

Dr Rick Mohr
tel. 21 3745

DR MOHR joined the department as an Honorary Senior Fellow during the year. His research, primarily resulting from

commissioned projects, focuses on urban social issues and the importance of identities of place and space in urban life. He has recently completed a study for Telecom on the importance of the telephone for older people.

Astronomy and Astrophysics Projects

Dr Paul Nulsen
tel. 21 3523

PAUL NULSEN continues to work on the development of numerical codes for the study of gas flows in astrophysical situations. Astrophysical problems commonly involve very large ranges of scale. Most fluid codes are poorly adapted to this type of problem, particularly when dealing with flows in more than one dimension.

Formation of jets

One area for the application of these fluid codes is in the formation and propagation of jets. Collimated outflows of gas occur in a wide range of astrophysical objects. Nulsen has recently begun investigating hydronamical models for the formation and driving of jets. Unlike most of the current models, the new model does not rely on magnetic fields to couple energy from a disk in the outflowing jet. Instead, frictional heating of gas above a disk is efficiently converted into kinetic energy in a collimated gas flow.

Department of Modern Languages

Associate Professor
Gaetano Rando
tel. 21 3644

RESEARCH activity over 1991-92 was concentrated on in print and launch stages of a scholarly book on the Italian community in Australia in conjunction with the Centre for Multicultural Studies. The book was published both in Italy and Australia (see *Italo-Australians* and *Australia's Italians* under 'Research Publications') and

was the result of a project funded (\$120,000) by the Giovanni Agnelli Foundation of Turin subsequent to successful negotiations with the Foundation by Professor Castles and Gaetano Rando. A contract for the publication of an English version of this book was recently awarded by Allen & Unwin and this version is also currently in the translation/in print stage.

Work is proceeding also on the publication of the third volume (funded by Transfield Pty Ltd) of the proceedings of the international conference on the Italians in Australia – the first 200 years, held by the Department in 1988. (The first volume was published in December 1990 and attracted a publishing grant of \$2000 from the Italian Consulate General, Sydney. The second was published in May 1991 with a publishing grant of \$3708 from the Australia Council.)

Department of History and Politics

Dr Steven Reglar
tel. 21 3708

MOST OF Dr Reglar's research time was spent on two related projects. First project was co-authoring a book entitled *China: Politics and Society*, with Professor Brugger of Flinders University, due for publication by Macmillan and Co., London, in January 1993. The book covers ideological disputes, public administration, law and policing, economic policy, state and urban life, state and countryside, gender relations, the role of intellectuals, minority nationalities and the generation of political, economic and social inequalities. A draft of some nine-ten months of the book is now being edited to the publisher's recommendations.

Second project: Reglar has written a draft of more than half of a book on the Chinese economy since 1942, tentatively titled *The Theory and Practice of Chinese Political Economy*. When the first project is completed he will complete the draft and seek a publisher. The work examines theoretical debates in Chinese economics, problems of policy formulation and im-

plementation and their political implications. He covered the political disputes which follow from both organisational and macro economic issues of development and reform.

Government and Industry Policy Debates in Australia

Dr Reglar has been researching the political issues arising from the implementation of restructuring policies in Australia under the Hawke and Keating administrations and the policies of the Peacock, Howard and Hewson oppositions. This research looks at the policies and their consequences for Australian political life and for the future of the Parties themselves and democracy in Australia.

Department of Philosophy

Dr David Simpson
tel. 21 3620

DR DAVID SIMPSON'S chief area of research is in the philosophy of language, with a special focus on theories of communication and interpretation. He is preparing for publication material on the pre-suppositional background of communicative interaction and on the implications and consistency of interpretive holism.

Department of Biology

Associate Professor Ted Steele
tel. 21 3434

Mechanism of somatic and germ-line evolution of antibody variable region genes

THE BIOLOGY laboratory is contributing to understanding of the mechanism of somatic hypermutation in mammalian antibody variable region genes. In the process researchers are also examining how the repertoire of germ-line V genes have arisen and how this diverse array has been maintained over evolutionary time. Work in 1992 – Mr H S Rothenfluh, PhD scholar, and Dr G W Both, Com-

monwealth Scientific & Industrial Research Organisation (CSIRO), North Ryde – has been presented at the International Congress of Immunology in Budapest and at two international Fenner conferences in Canberra at which both researchers were invited to participate/organise. Their data show that the region of DNA copied into RNA (the 'transcription unit') is the preferred target for the hypermutator mechanism. This conclusion is consistent with an earlier prediction arising from the Reverse Transcriptase Model published by Steele and Pollard in 1987 (*Molec. Immunol* 24:667).

Currently the data are being consolidated and attempts are being made to develop ways to analyse the mechanism both *in vitro* and *in vivo*.

On the other front the researchers are analysing the genetic structure of the germ-line VH segments which have been laid down during phylogeny.

Department of Mathematics

Associate Professor Keith Tognetti
tel. 21 3826

THE CIRCLE map may be defined as follows: consider a circle of unit circumference. Then we can regard the point j as being placed at the clockwise distance x_j around the circle from the origin, where μ is irrational and $x_j = \{x_{j-1} + \mu\}$. In the special case where μ is equal to the golden section, the associated gaps sequence becomes the Golden Thread (another alias is the Fibonacci word). Such Threads are rich in self reference and can be discovered in all sorts of natural structures as well as in artifacts such as the Penrose tiles and computer storage schemes (hashing). Symbolic sequences arising from this and other iterative maps have been shown to display the folding and stretching which characterise chaotic structures. A metric is being developed for pattern matching which exploits the self similarity properties of such sequences.

Another important recent development is in the collaborative work with Dr Jeff

Dewynne (Southampton) which explores the connection between these patterns and Sturmian Trajectories – based on the work of Marston Morse. This examines the distribution of the zeros of second order differential equations with periodic coefficients (Floquet theory).

Developmental work on two fronts is also taking place in the area of artificial life. First string structures arising out of the above map are being reformulated as emerging artificial life entities. Secondly, the Tierra model which uses genetic concepts to model self replication of computer creatures is being simplified so as to develop an analytic framework. Work in this area has also highlighted the importance of developing a better understanding of randomness; the driving force of variation in such models and also the necessity of obtaining a mathematical construct for the 'environment'. The study will help frame questions about the evolution of more complex computer systems and how to defend computer systems against intelligent and adaptive viruses.

Projects in progress

'On the Self Matching Properties of [jt]'.
'The Interest Rate in risk Analysis when the Returns are Random Variables'.
'The Telegraph and Gray Codes, Chaos and Games'.
'Sturmian Codes and the Circle Map'.
'Order out of Chaos'.
'Self Matching in Golden Strings'.

Department of Philosophy

Dr Suzanne Uniacke
tel. 21 3604

SUZANNE UNIACKE has completed her book manuscript entitled *The Self-Defence Justification of Homicide*. She has also published material on partial excuses to murder, euthanasia, and self-defense and natural law.

Department of Sociology

Ms Trish Vezgoff
tel. 21 4055

MS VEZGOFF is working in two main areas. Her PhD research is examining the issues in teacher stress, primarily focusing on women teachers in the secondary school system. She is also carrying out work on cancer screening programs and quality assurance in medical practice.

Department of History and Politics

Dr Adrian Vickers
tel. 21 3626

Current research areas: *Historical discourses on the South-east Asian cockfight.*

THE PRE-COLONIAL construction of South-east Asian identity through the concept of the *pasisir* or coastal culture.

During 1991 Dr Vickers continued research on his project on the cockfight in South-east Asia, visiting Thailand as a new research site in this topic. This trip showed that, contrary to expectations, it would be difficult for him to research this topic in any depth without fluency in Thai. He was, however, able to gain preliminary data and to organise a translation of a key article on the subject in Thai. He was also able to collect more information from the Philippines and Indonesia on the topic.

A paper from this research was delivered at the International Bali Studies Conference at Princeton University in 1991, and is being revised for publication in early 1993.

Part of this research will be incorporated into the complete manuscript of the book based on Dr Vicker's PhD thesis. This has the working title of *Journeys of Desire: The Balinese Malat in Text and History*, and three publishers have expressed interest. This manuscript was completed over the 1992 Christmas break.

Dr Vickers has had accepted for publication by the journal *Archipel* a paper on the concept of 'Coastal' or Pasisir culture in pre-colonial South-east Asia; it is due to appear in 1993. Another paper, on the re-

lated topic of Pañji stories and modernity, was given at the Asian Studies Association of Australia conference in 1992.

At the Princeton Conference Dr Vickers took on the task of editing some of the conference papers for publication. The revised papers were sent off to Yale University South-east Asia centre publications in October, under the working title *Being Modern in Bali*.

The Princeton papers have involved extending his research into the area of modernity in South-east Asia, a topic on which he wrote one article in 1992 and gave one conference paper. This research has meant a continuation of his major approach of studying history through literature – but has meant that he will be shifting his research affiliation to the Asia-Pacific Research Program in 1993.

Department of Physics

Associate Professor
Bill Zealey
tel. 21 3522

Astronomy and Astrophysics Project

The Astronomy and Astrophysics Group has active observational, theoretical and instrumentation development programs. Individual staff share a common interest in instrumentation, particularly that associated with image analysis.

Image Digitising and Analysis

Two PC/AT based video digitising systems provide a basic image analysis facility. These have been integrated with a CDROM drive and used in the analysis of radar images of Venus.

Design and construction of CCD camera electronics as part of the development of a high-speed plate measuring system program were completed. This system will provide an advanced measurement facility for the analysis of UK Schmidt Telescope plate material.

Low surface Brightness Galaxies

Bill Zealey and Terry Coleman studied the dynamics of several low surface brightness galaxies. A survey of the avail-

able SERC/ESO Sky Survey material was made using the video digitising systems to provide a source list of low surface brightness galaxies. The first HI radio maps were successfully made in 1992 of NGC5291 using the Australia National Facility's Compact Array [ATNF] at Narrabri.

Protostars and Jets

During their early years young stars produce supersonic winds which blast out into the surrounding material. Such outflows provide the best available opportunity for the study of astrophysical jets.

Bill Zealey, Mark Suters and Phil Randall used the Anglo Australian Observatory's infrared camera, IRIS, to image several jets. Molecular emission was seen in HH1/HH2, HH46/HH47 and HH110. *For the first time*, infrared molecular emission was observed from the edges of the outflow cavities.

The researchers began a multi waveband study of major outflows in collaboration with astronomers at CSIRO and JILA, Colorado. Mark Suters observed on the Caltech Millimetre Telescope [Hawaii] before continuing to Boulder. Infrared maps of R.Cra show molecular hydrogen emission from shocked gas associated with the radio continuum jet emission.

Cometary globules

Phil Randall has continued to study the dust distribution of the central part of the Gum Nebula using The Infrared Astronomical Satellite [IRAS] data. Infrared maps of a number of cometary globules have been made using IRIS.

Studies of the Surface of Venus

In 1990 NASA's Magellan spacecraft began to image Venus using radar. The availability of radar images on CDROM has allowed us to engage in planetary physics projects at an early stage of the Magellan mission.

Bill Zealey and Graeme Melville are concentrating on identifying classes of structure which include lava tubes and impact craters, and are directly comparable to terrestrial structures. Graeme Melville travelled to Mount Surprise to study the terrestrial counterparts of Venusian lava tubes.

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Ford, A, *Alchemy-Synergy-Eugene*, Goosens Hall, ABC Ultimo Centre, Sydney, 1992. Commissioned by the performer(s) with financial support from the Performing Arts Board of the Australia Council.

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Ford, A, *Harbour*, Gerald English (tenor), Australian Chamber Orchestra, conductor: David Stanhope, Museum of Contemporary Arts, Sydney, 1992. Commissioned by the performer(s) with financial support from the Performing Arts Board of the Australia Council.

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Gentle, I R, ASER. Sculpture Proposal, ASER. Complex, Adelaide.

Hook, R, Design and production of boardroom table for new Youth Centre, Burelli St, Wollongong. 1992

Schultz, A, *The Devil's Music* (Contrafactum II: 'Mephisto'), commissioned by the Australian Broadcasting Corporation and the Performing Arts Board, Australia Council for the Sydney Symphony Orchestra.

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COMPOSITIONS/ARRANGEMENTS

Dixon, J W, New orchestration of Parry's 'Jerusalem' for use by City of Wollongong Symphony Orchestra.

Dixon, J W, Revised version of 'A Foursome of Twosomes', 1983.

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Heim, C, *Starlight*, a two and a half hour music/theatre work produced at the Hope

Theatre, University of Wollongong, August 1992.

Vance, D, *Here we go 'round the orchestra*, (for orchestra and children's chorus) composed for the BHP Youth Orchestra Popular Proms program First performance, 28 June 1992, Hope Theatre.

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Conroy, D, 'Textiles and Marginality: from the outside looking in', *Object*, March 1992, p 19-22.

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PUBLIC BROADCASTS AND RECORDINGS

Ford, A, 'Bennett', *Sounds Interesting*, Sydney, ABC-FM, 1992.

Ford, A, 'Birtwistle', *Sounds Interesting*, Sydney, ABC-FM, 1992.

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OTHER RECORDINGS

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Ford, A, 'Epithalamium', Gerald English (tenor), Alice Evans (violin), Michael Askill (bell), Huntington, ABC, 1991.

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Schultz, A, 'Hit List', The Song Company, Sydney, ABC, 1992.

Schultz, A, (arranger), 'Stille Nacht', Australian Youth Orchestra, Sydney, Tall Poppies, 1992.

OTHER ORIGINAL WORKS

Butler, R (Curator), *My Head is a Map*, A Decade of Australian Prints, Australian National Gallery, Canberra, 1992, pp 60-61.

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Schultz, A, *Dead Songs*, Sounds Australian, Sydney, 1991, pp 59.

Schultz, A, *Stick Dance 3*, Sounds Australian, Sydney, 1992, pp 10.

CONSULTANCIES

Conroy, D, Committee (NSW member) to select and curate work for an exhibition of Australian Tapestry at the Jam Factory, Adelaide, in 1994

Conroy, D, Committee member of Taiwan – Australia Exhibition Exchange Project, to research, curate, and organise exhibitions in both countries in 1993/1994.

Conroy, D, Selection panel and committee at Goulburn Regional Gallery, to curate and select artists for two textile exhibitions to be held in 1993 on 'Aspects of Design' and 'Environment'.

McGrath, I, Consultant and Course Co-ordinator for National Aboriginal and Islander Skills Development Association, technical training courses.

EXHIBITIONS

Conroy, D, 'Archaeologies: Images, Vestiges, Shadows' with Lindsay Duncan (ceramicist) at the Wollongong City Gallery, Burelli Street, Wollongong, June - July 1992.

Duncan, L, *Archaeologies*, exhibition of ceramic sculptures, Wollongong City Gallery, Wollongong, 1992.

Duncan, L, *Images of Men – Representations of Masculinity*, exhibition of ceramic sculptures, Art For Art's Sake Gallery, Wollongong, 1992.

Duncan, L, School of Creative Arts Staff Biennale, group exhibition, ceramic sculpture, Long Gallery, University of Wollongong, 1992.

Duncan, L, Wollongong Ceramic Society, group exhibition of ceramic sculpture, Wollongong Court House, 1992.

Gentle, I R, 'Contact-Graduates of the National Art School', Ten Taylor Street Gallery, September 1992.

Gentle, I R, 'Graeme Sturgeon Benefit Exhibition', Macquarie Galleries, Sydney 1991.

Gentle, I R, 'Illawarra Sculptors Exhibition', Art Arena Gallery, Wollongong, November 1992.

Gentle, I R, 'Interactions' SCA Staff Exhibition, Long Gallery, University of Wollongong, September 1992.

Gentle, I R, 'Scarp' Exhibition, Wollongong City Gallery, May 1992.

Gentle, I R, 'Son et Lumiere', The King's School, September 1992.

Gentle, I R, 'The Environment Exhibition', Long Gallery, University of Wollongong, June 1992.

Gentle, I R, 'The Found Line' One-Person Exhibition, Wollongong City Gallery, October 1992.

Gentle, I R, 'The Goulburn Region-Six Artist's interpretation', Goulburn Regional Gallery, October 1992.

Hook, R, *Interactions* - Long Gallery, School of Creative Arts, September 1992.

Hook, R, *Print Show* - Long Gallery, School of Creative Arts, August 1992.

Hook, R, Solo exhibition of paintings for Editions Galleries, Melbourne, January - May 1993.

Orchard, K 1991 **Embracing Space**, Art Gallery of Western Australia, Perth.

Orchard, K 1991 **White Terrace**, Centre for Contemporary Art, Hamilton, New Zealand.

Orchard, K 1992 Group Exhibition, Claybrook Gallery, Auckland, New Zealand.

Orchard, K 1992 Roslyn Oxley 9 Gallery, Sydney.

Orchard, K **Facsimilies**, Waitakere Arts and Cultural Centre, Auckland, New Zealand.

Orchard, K **Interactions**, School of Creative Arts 1992 Staff Show, Long Gallery, University of Wollongong.

Orchard, K **My Head is a Map**, A Decade of Australian Prints, The National Gallery, Canberra.

Orchard, K **Paral/laxis**, Claybrook Gallery, Auckland, New Zealand.

Orchard, K **Short Circuit**, Art Gallery of Western Australia, Perth.

Orchard, K **Sign-age**, Rotorua Art Gallery and Museum, Rotorua, New Zealand.

Orchard, K **The Print Show**, Long Gallery, School of Creative Arts, University of Wollongong.

Rowley, S, 'Inset' photographic series, *Interactions - SCA Staff Exhibition*, The Long Gallery, September 1992.

Shepherd, P L, *Interactions*, Long Gallery, University of Wollongong, September 1992.

Van den Berg Jelle, *Euro Day Art Exhibition*, Alliance Francaise, Sydney, May 1992.

Van den Berg Jelle, *Interventions*, School of Creative Arts Staff Show, Long Gallery, University of Wollongong, September 1992.

Van den Berg Jelle, *Miniatures*, Realities Gallery, 35 Jackson Street, Toorak, Victoria, February 1992.

Van den Berg Jelle, *Pacific - Between Eagleton and Coledale*, Mori Gallery, Sydney, February 1992.

Van den Berg Jelle, *Recent Paintings*, D'eendt, Amsterdam, The Netherlands, March 1992.

Van den Berg Jelle, *Seen the Light*, Realities Gallery, Melbourne, April 1992.

Van den Berg Jelle, *Watercolours*, Chapman Gallery, Canberra ACT, August 1992.

Van den Berg Jelle, *Conversions*, Installation with Jacky Redgate, Canberra Contemporary Art Space, Canberra ACT, July 1992.

Warren, J, BMG Fine Art Galleries, Adelaide, South Australia, April 1992.

Warren, J, Macquarie Galleries, Sydney, November 1991.

Warren, J, Von Bertouch Galleries, Newcastle, August 1992.

POEMS

Pretty, R, *Angler*. The Sydney Morning Herald, 18 April 1992.

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Pretty, R, *Juggler*. The Weekend Australian, October, 1991.

Pretty, R, *Paterson's Curse*. Westerly March 1992.

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Scott, J A, 'Sonnet', *Voices*, Vol. 1 No. 4, Summer 1991-2, pp 39.

Scott, J A, and Brooks, D, 'Eight Translations from *Les Délivrescences d'Adoré Floupette* (1885)', *Southerly*, No. 3, 1992, pp 176-181.

Scott, John A, 'Elegy 7 by Emmanuel Hocquard' (translation from the French), *Shearsman* (Plymouth, UK.), New Series, No. 4, 1991, pp 1-15.

PROSE FICTION

Scott, J A, 'What I Have Written', *Scripti*, Vol. 8 No. 1, August 1992, pp 188-239.

PERFORMANCES

Bloomingdale's House of Music, New York City, 27 October 1992.

Dixon, J W, Music Director, City of Wollongong Symphony Orchestra. Directed four subscription concerts at Illawarra Performing Arts Centre with guest appearances by Roy Howard, Piano; Keith Hempton, Bass; Danielle Everett, soprano; Figtree High School String Ensemble; Brian Martin; University Singers and Roman Rudnytsky, Piano.

Ford, A, ...les debris d'un reve, Kathleen Gallagher (piccolo), Old Darlington School, Sydney, 8 October 1992.

Ford, A, Alchemy-Synergy-Eugene Goosens Hall, ABC Ultimo Centre, Sydney, 23 May 1992.

Ford, A, At a Slight Angle . . . , Bronwen Jones (bass clarinet),

Ford, A, Epithalamium, Gerald English (tenor), Alice Evans (violin), Michael Askill (bell), Huntington Festival, Huntington Estate Winery, Mudgee, 30 November 1991.

Ford, A, Harbour, Gerald English (tenor), Australian Chamber Orchestra, conductor: David Stanhope, Museum of Contemporary Arts, Sydney, 10 May 1992.

Ford, A, Pastoral, Tasmanian Symphony Chamber Players—St Helens, Tasmania, September 1991.

Ford, A, The Laughter of Mermaids (words by Maria Blakey), The Song Company, Hope Theatre, University of Wollongong, 16 March 1992.

Heim, C, Conductor *Joy To The World*, The University Singers' Christmas Concert, Wesley Church on the Mall, December 1991.

McGrath, I, Devised, directed, designed and performed Son et Lumiere production of Coleridge's 'The Rime of the Ancient Mariner' 23-25 July 1992, Hope Theatre, University of Wollongong.

Schultz, A, 'Attack', Patricia Pollett (Perihelion). Brisbane, June 1992.

Schultz, A, 'Barren Grounds', The Seymour Group, Sydney, May 1992.

Schultz, A, 'Calling Music', The Hunter Orchestra cond Roland Peelman, Newcastle and Muswellbrook, September 1992.

Schultz, A, 'Ekstasis', The Song Company, Pennant Hills, March 1992; Musica Viva, Springwood, March 1992; Newcastle, April 1992; Sydney, May and September 1992; Wollongong, May 1992; Melbourne, July 1992.

Schultz, A, 'Hit List', The Song Company, Sydney, May and September 1992; Melbourne, July 1992.

Schultz, A, 'Sea-Change', Bernard Lanskey, Ipswich, August 1992.

Schultz, A, 'Sea-Change', Robert Zocchi, University of Newcastle Conservatorium, October 1991.

Schultz, A, 'String Quartet', Guild Hall New Music Ensemble, Barbican Centre London, November 1991.

Shepherd, P L, Musical Director - *The Desert Song*, Romberg, S, Illawarra Performing Arts Centre, July 1992.

Shepherd, P L, Musical Director - *The Gondoliers*, Gilbert & Sullivan, Illawarra Performing Arts Centre, November 1991.

Shepherd, P L, Musical Director - *The Student Prince*, Romberg, S, Illawarra Performing Arts Centre, November 1992.

University Music Centre, September 1991.

Vance, D, (conductor) , BHP Youth Orchestra. St. George's Basin, September 1992.

Vance, D, (conductor) Concert by BHP Youth Orchestra, University Music Centre , Berry, May 1991.

Vance, D, (conductor) Hope Theatre: Opening Gala Concert, BHP Youth Orchestra and University Singers, October 1991.

Vance, D, (conductor), Conservatorium Concert, BHP Youth Orchestra and University Singers. Hope Theatre, November 1991.

Vance, D, (conductor), Popular Proms Concert. Prokofiev: *Peter and the Wolf*, BHP Youth Orchestra. Hope Theatre, June 1992.

Vance, D, (conductor/arranger) *Moonlight Serenades* ; University Singers, Bridge St. Theatre, 8 June.

Vance, D, (piano) Art of Lunch Recital with Hartmut Lindemann, Viola.

Vance, D, (piano) Schubert: *Schwannengesang* Art of Lunch Recital with Keith Hempton, Baritone University Music Centre, September 1992.

Vance, D, (piano), Duet recital with Marilyn Meier. Gledswood Homestead, Camden, September 1992.

Vance, D, (conductor) Rossini: *Stabat Mater* , BHP Youth Orchestra and University Singers, Hope Theatre, April 1992.

Vance, D, (conductor), *Tell me the Truth about Love* University Singers, Berry, July 1991.

PRODUCTIONS

Copeman, P, (playwright and director), *Hearts and Minds*, Theatre South, Wollongong, 8-24 May 1992.

Kevin J, Director, Agents Auditions, Graduating Acting Class, 1992, Wharf Theatre, Sydney, October 1992.

Kevin, J, Director, *Steel Magnolias*, Robert Harling, Performance Space, University of Wollongong and Theatre South, September-October 1992.

Kevin, J, Performer, *A Christmas Carol*, Charles Dickens, Director Des Davis, Theatre South, November-December 1992.

Kevin, J, Performer, *King Richard III*, Shakespeare Director, Des Davis, Theatre South Tour, Parramatta, Mittagong, April 1992.

Kevin, J, Performer, *The Cherry Orchard*, Anton Chekhov, Director Des Davis, Theatre South, October 1991.

Kevin, J, Performer, *The Miraculous Mellops*, Millium Pictures Television Mini-series, Capital TV, Director Karl Zwicky, Producer Posie Graeme-Evans, April-July 1992.

Kevin, J, Performer, *The Miraculous Mellops*, Millium Pictures Television Mini-series, Capital TV, Director Karl Zwicky, Producer Posie Graeme-Evans, September-November 1991.

Kevin, J, Performer/Dialogue Coach, *The Student Prince*, Sigmund Romberg, Director Robert Peet, Illawarra Performing Arts Centre, November 1992.

RECORDINGS

Dench, C, *Driftgals* for percussion and five amplified instruments, on OenMone, played by Elison.

Dench, C, *Gelb: Violett* for alto flute, on Ossia: Australian Composers, Vol. 1, played by Laura Chislett.

Dench, C, *Sulle Scale dalla Fenice* for flute on Perspective of New Music.

Dench, C, *Sulle Scale della Fenice* for flute, on Vos Australis, played by Laura Chislett.

GRADUATE SCHOOL OF JOURNALISM

BOOK

Lloyd, C, Troy, P and Schreiner, S, *For the Public Health: The Hunter District Water Board 1892-1992*, Longman Cheshire, 1992, 364 + v1 pp, includes index.

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Lloyd, C, 'The Case for the Media', Young, P (ed) *Defence and the Media in Time of Limited War*, Frank Cass, London, 1992, pp 44-68.

JOURNAL ARTICLE

Lloyd, C, 'Small Wars and Insurgencies', Frank Cass, London, 2, 3, 1991, pp 44-68.

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DEPARTMENT OF ACCOUNTANCY

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Gaffikin, M J R, *Accounting Principles*, Harcourt Brace Jovanovich, 3 ed, Sydney, 1992, 980 pp.

Shannon, R, *Manual of Suggested Solutions, Theory and Practice of Australian Auditing*, 2nd ed, Thomas Nelson, 1991.

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